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Analysis to Reduce Emission Characteristics for Gas Turbine Combustion

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ABSTRACT
The main aim of this paper is a determine to reduce emission characteristic for gas turbine combustion. In semi-empirical method of annular combustor design, there is a prediction for emission products (like nitrogen dioxide (NOx), carbon monoxide (CO), hydrocarbons (HC), smoke and residents) etc. To calculate the amount of emissions for flight operating conditions and landing takeoff condition where high radiation (NOx) occurred. In lean premix staged combustion, fuel and oxidizer (air) mixed before combustion at primary zone and it's entirely different from diffusion flame combustion because combustion takes place simultaneously mixing of fuel and oxidizer (air). So lean premixed staged combustion process is the best way to reduce emission to minimize equivalence ratio of primary zone of annular combustor, so that its control the emission. In this method, we control emission through reduce specific fuel consumption (SFC) at landing and takeoff cycle (LTO cycle) and fuel-air ratio compare with stoichiometric equation of fuel and oxidizer (air). The engine thermodynamic state is mainly determined by the thrust demand of the aircraft, the ambient conditions and different flight missions have to be considered. Therefore a flight performance module is presented by using the technique of lean-premix combustion to control the emission and to improve the performance of engine SFC.

Key Words: Gas turbine emission control, Gas turbine emission, Gas turbine combustion.

I INTRODUCTION

A typical lean premix staged (LPS) combustion can be dependent on the three main factor.

(a) Fuel injection
(b) fuel vaporization
(c) fuel air mixing

The function is to achieve complete evaporation and complete mixing of fuel and air before combustion. By eliminating droplet combustion and supplying the combustion zone with a homogenous mixture of low equivalence ratio, the combustion process proceeds at a uniformly low temperature and very little NOx is formed. The flame is stabilized by the creation of one or more recirculation zone, because combustion is completed in this region and emission will be low and it can be improved with variation of SFC. A useful by product of lean premix staged combustion is that essentially free from carbon formation especially when gaseous fuel are used, so LPS combustion is more appropriate.

II GAS TUBINE COMBUSTION PROCESS

In gas turbine combustion, there are three zones:

(a) Primary zone
(b) Secondary zone
(c) Dilution zone

In primary zone 85% combustion occurred rest of the combustion takes place in secondary zone. Burned gases chilled into dilution zone due to uniform temperature need and it's entered to the turbine section. Gas turbine combustion schematic diagram given in below.

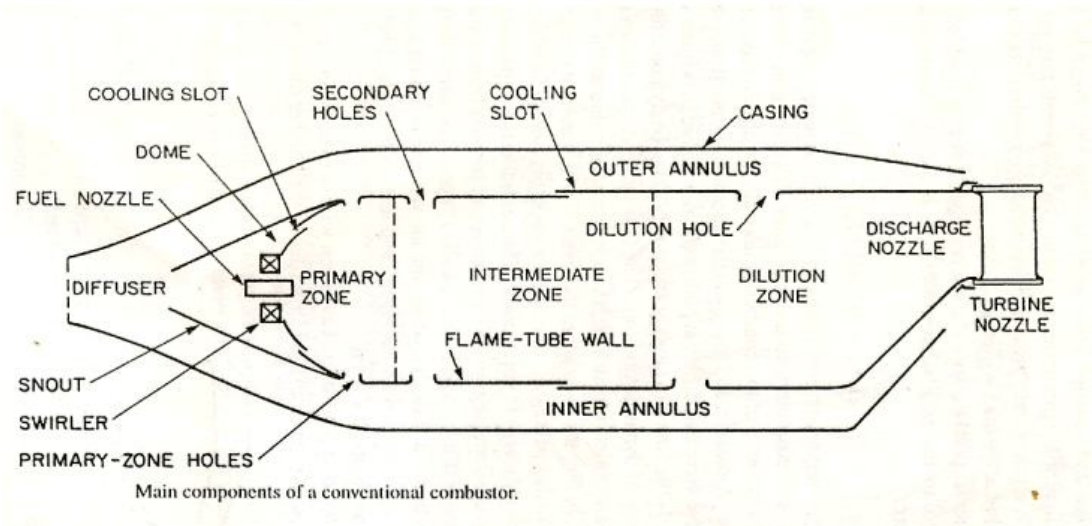

Fig. 1 Gas Turbine Combustion

III COMBUSTION EFFICIENCY

Combustion efficiency of gas turbine combustors should be very close to 100% if fuel and air are well mixed in proper proportions, ignited and given proper time to burn. In usual industrial application, these conditions are generally met. In the aero gas turbine engines, the combustor size is critical. It has always proven advantageous to design for operation near the limits of combustion intensity. Furthermore, aero engines combustor operates over a wide range of inlet temperatures, fuel-air ratios at flight altitudes with the result that the combustion performance may deteriorate at high altitude. Combustion efficiency of a gas turbine depends on various processes taking place in the combustor primary zone. Combustion taking place in the primary zone can be treated as three sequential processes: evaporation, mixing and chemical reaction. All these processes can be nominally expressed and be linked with combustion efficiency as a function of:

$$Efficiency = f(A/F)^{-1}\left[\left(Evaporation\ rate\right)^{-1} + \left(Mixing\ rate\right)^{-1} + \left(\mathrm{Re}action\ rate\right) - 1\right]^{-1}$$

Combustion efficiency is defined as the percentage of available chemical energy in the fuel which is converted to heat energy within the combustor. Specific Fuel Consumption (SFC), the ratio of fuel consumption rate to net engine thrust, and total fuel consumption are both proportional to combustion efficiency.

$$\eta = \frac{T_p - T_a}{T^* - T_a}$$

Where,

T_p = Temperature of the Products of Combustion.

T_a = Temperature of the air.

T^*= Adiabatic Flame Temperature.

To make the analysis of the combustion process and for describing combustion efficiency, two approaches are most widely used, the burning velocity model and the stirred reactor model. The burning velocity model is commonly used in describing the combustion phenomena in a gas turbine combustor**.**

IV EMISSION CAUSE

The gas turbine engine emissions offer the greatest potential threats to the stratosphere are:-

(a) Water vapour and carbon dioxide which could produce a “green house effect” on the earth atmosphere.

(b) Sulfur compound leading to particulate formation, which could divert solar radiation away from the earth and removing sulfur at refinery

(c) Oxides of nitrogen, which could deplete the ozone layer and allow to increased penetration of solar u.v.rays.

(d) NO_x(NO, NO_2 and N_2O) emitted from combustion process is a atmospheric pollutants and its response for formation of ground level smokes and fine particle and heat radiation(radiate the pollution) to effects on respiratory system of human and animals and living organism.

Thus the emission of main interest is NO_x because its reaction with ozone in the atmosphere and to control of NOx emission is a world-wide concern. The reaction mechanism can be expressed as

$$NO + O_3 \rightarrow NO_2 + O_2$$

$$NO_2 + O \rightarrow NO + O_2$$

V REDUCTION OF EMISSION ON SPECIES

It has been the practice in the past design primary zones to operate at or above the stoichiometric mixture strength, to minimize combustor size and assist in ignition. Therefore a limit to the level of NO_X reduction can be achieved in this way.

For stoichiometric eq^n:

$$C_{12}H_{23}\ (Fuel) + [O_2 + N_2] \rightarrow CO_2 + H_2O + N_2$$

For lean mixture:

$$C_{12}H_{23}\ (Fuel) + 17.75\,[O_2 + 3.76\,N_2] \rightarrow 12\,CO_2 + 11.5\,H_2O + 3.76X17.75N_2$$

For Rich mixture:

$$n\,C12\,H_{23}\ (fuel) + [O_2 + 3.76\,N_2] \rightarrow CO_2 + H_2O + N_2 + O_2 + CO$$

Where n = nos. of moles of fuel

VI EMISSION REGULATION

The International civil Aviation organization (ICAO) has promulgated regulations for civil subsonic turbojet/turbofan engines with rated thrust level above 26.7kN (6000 pounds) for a defined landing takeoff cycle (LTO) which is based on an operational cycle around airports. This LTO cycle is intended to be representative of operation performed by an aircraft as it descends from an altitude of 914 m(3000 ft) on its approach path to the time it subsequently attain the same altitude after takeoff.

Emission emitted during the LTO cycle per kilo newton (KN) of rated thrust at sea level.

We have,

Emission (g/kN) = Emission index (g/kg fuel) X Engine SFC (kg fuel/hrkN) X Time in Mode (hr)

This equation shows that two methods are available to the engine manufacturer for reducing Nox. One is to make improvements to the combustor that reduce its emissions index (EI) and the other is to choose an engine cycle that yield lower SFC, because the CO and UHC level of modern gas turbine engine have been significantly reduced at all low power conditions and only Nox is emitted in appreciable amount at altitude cruise in practice the emissions generated by aircraft engine consist primarily Nox. The ICAO standard for smoke measurement is expressed in terms of a smoke number (SN), which is related to the engine takeoff thrust (F_{00}),

$$SN = 83.6\ (F_{00})^{-0.274}$$

ICAO standards for gaseous emission are presented in below drawn table 1, which π_{00} is engine pressure ratio at takeoff and SN expression is shown graphically, shown given below.

Table1:
ICAO gaseous emissions standards

EMISION, g/kN	SUBSONIC TURBOJET/ TURBOFAN ENGINES	SUPERSONIC TURBOJET/ TURBOFAN ENGINES
HC	19.6	$140/(0.92)^{\pi}{}_{00}$
CO	118.0	$4550/(\pi_{00})^{1.03}$
NOx	32+1.6T	$36+2.42\pi_{00}$

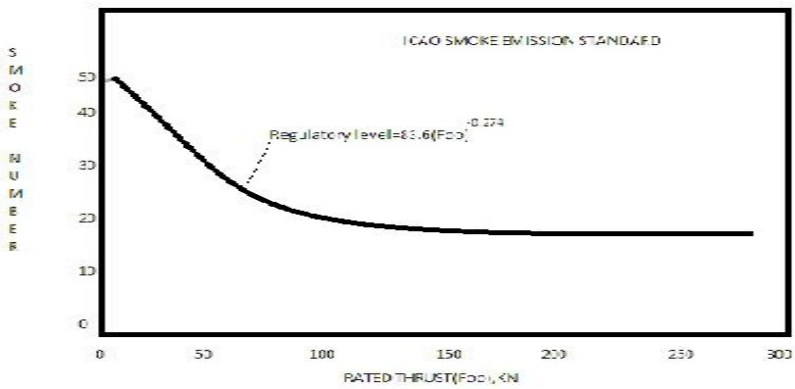

Fig.2 ICAO Smoke Emission Standards

VII METHODS OF EMISSION REDUCTION

The main factors controlling emissions from gas turbine combustion may be considered in following reason:-

(a) The primary zone temperature and equivalence ratio closer to around 0.8.

(b) The degree of homogeneity of the primary zone combustion process.

(c) Residence time in the primary zone (increase in primary zone volume).

(d) Liner wall quenching characteristics.

(e) Fuel rich primary zone designs.

(f) Improved fuel atomization process.

(g) To use Water injection

(h) Fuel staging

VIII APPROACHES TO THE DESIGN OF LOW EMISSION COMBUSTOR

To design the low emission combustor , improved in variable geometry like swirl of air fuel mixture and lean premix stage combustion in that flame blowout at lower power condition, so fuel consumption(combustion efficiency),durability, maintainability and safety consideration, must be taken into account in future application of lean premixed staged combustion techniques to engine combustors design.

IX CONCLUSION AND FURTHER WORK

The great potential of the LPS combustion concept for ultralow emissions combustors has led NASA to establish its stratospheric cruise emission reduction program**.** These programs will effective for all air-fuel ratio, there is a certain emission species value will get. Special emphasis is placed on achieving very low Nox emission level at stratospheric cruise conditions. Combustor operating (pressure, temperature and burning zone equivalence ratio), residence time, reference velocity, combustor and various fuel-air mixing characteristics, such as spray angle. The main objective is to examine the factors influencing the performance and emission characteristics of LPS combustion.

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Solar Photovoltaic and Biogas Technologies towards Sustainable Rural Development: Research Dimensions

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I INTRODUCTION

The hundreds of millions of people in India live in villages in abysmal condition without basic amenities like electricity, sanitation facility, drinking water and cooking gas. According to the Census of India Report 2011: 64 percent of rural population of our country uses firewood, 13 percent crop residue and 12.8 percent use cow dung for cooking and 56 percent of our rural population uses kerosene for lighting. One of the main causes of lack of progress in rural areas is the inadequate and unreliable electricity supply and modern energy services. Energy is a basic human need and is the driver of socio – economic development. The country power installed capacity of 245268MW (Annual Report 2013 -14 of the MNRE, Government of India: This includes 31702 MW of power from renewable energy sources). But a major portion of power is consumed in cities leaving villages with minimal and erratic supply of power.

Sustainable development stands for protecting the environment and avoids depletion of resources. Poverty and the environment are linked in a 'downward spiral' in which people living in poverty are forced to overuse environmental resources for their daily survival thus are impoverished by the degradation of these resources in an unsustainable way. The challenge is to increase per capita availability of energy while ensuring that per capita carbon dioxide emission is kept well within limits so that central climate change related challenges are addressed. The villages do not lack renewable energy resources essential to generate power and change their material condition. Solar power in terms of thermal and photovoltaic power and wind are available in plenty. The cattle dung, human excreta and agricultural waste can be used to generate biogas. The slurry from biogas technology is excellent manure which can stop soil erosion. These sources can supply reliable and affordable energy for rural household needs, the needs of the rural –micro enterprises, irrigation and the needs of the other public services.

An attempt has been made here to identify challenges in developing realistic models of sustainable development based on solar photovoltaic energy and biogas.

II SOLAR PHOTOVOLTAIC TECHNOLOGY

India is endowed with vast solar energy potential. About 5,000 trillion kWh per year energy is incident over India's land area with most parts receiving 4-7 kWh per sq. m per day. Hence both technology routes for conversion of solar radiation into heat and electricity, namely, solar thermal and solar photovoltaic, can effectively be harnessed providing huge scalability for solar power in India. Solar also provides the ability to generate power on a distributed basis and enables rapid capacity addition with short lead times. From an energy security perspective, solar is the most secure of all sources, since it is abundantly available. Theoretically, a small fraction of the total incident solar energy (if captured effectively) can meet the entire country's power requirements.

Solar photovoltaic power generation is a method of producing electricity using solar cells. A solar cell converts solar optical energy directly into electrical energy. A solar cell is essentially a semiconductor diode fabricated in a manner which generates a voltage when solar radiation falls on it. Major advantages of solar cells over conventional methods of power generation are[1]: (i) Solar cells convert radiation directly into electricity using photovoltaic effect without going through a thermal process. (ii) Solar cells are reliable, modular, durable, and generally maintenance free. (iii) Solar cells are quite, benign, compatible with almost all environments, respond instantaneously to solar radiation and have lifetime of 20 or more years. Solar modules/panels can be located at the place of use.

Solar photovoltaic technology involves development of systems, based on electrical power generated by the solar cell, for various applications. Due to the statistical nature of the availability of sun systems need to account for this by providing storage capacity inbuilt to the system. As the solar photovoltaic power is statistical in nature power conditioning unit is essential in system design to the monitor and control the storage and supply of power.

Photovoltaic (PV) is a method of generating electrical power by converting solar radiation into direct current (DC) electricity using semiconductors that exhibit the photovoltaic effect (see Figure 1).

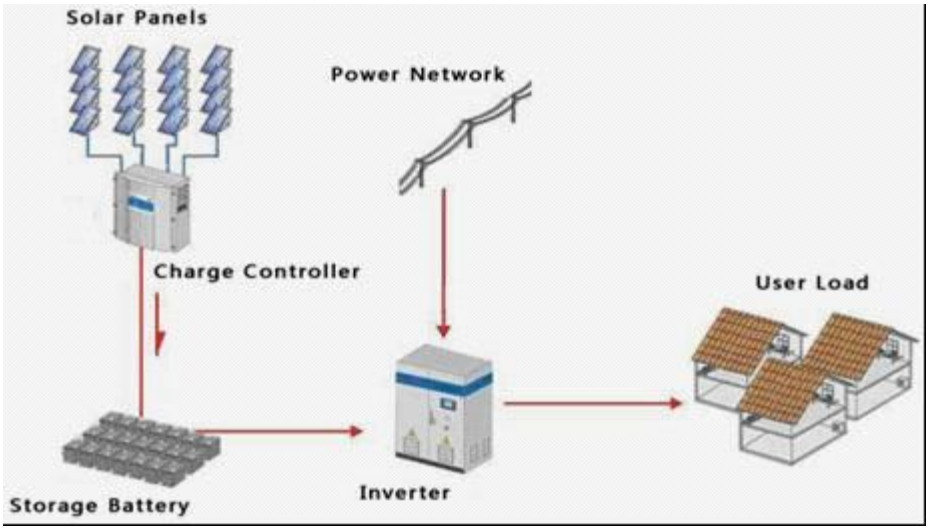

Fig. 1: A typical off-grid solar photovoltaic system

It can be seen from the Fig.1 that the power generated from a PV module/panel is influenced by solar irradiance. The irradiance changes during the day and therefore a maximum power point tracking (MPPT) is essential to get the maximum possible power from PV panel, in all conditions. The power conditioning unit is essential to the system. Battery-bank becomes essential for storage of generated power, where the system is not connected directly to the grid.

According to MNRE, Govt. of India renewable energy based systems can be categorized as:-

(a) Grid Connected Power Systems- are mainly private investment driven, with favourable tariff policy regimes established by State Electricity Regulatory Commissions (SERC), and almost all-renewable power capacity addition during the year has come through this route.

In addition the ministry is also giving importance to Bio-power. Bio-power:

Four sets of programmes are being implemented with the aim to generate competitively priced bio power and/or heat from agricultural, agro-industrial residues and plantations and urban & industrial wastes. These are:

(i) Biomass power/ bagasse cogeneration
(ii) Non-bagasse cogeneration
(iii) Biomass gasifier
(iv) Urban & Industrial wastes

(b) Off-Grid Power Systems- Distributed/decentralized renewable power projects using wind energy, biomass energy, hydro- power and hybrid systems are being established in the country to meet the energy requirements of isolated communities and areas which are not likely to be electrified in near future. Example- Solar PV Roof-top Systems for abatement of diesel for power generation in urban areas.

(c) Decentralized Systems- Renewable energy technologies are ideally suited to distributed applications, and they have substantial potential to provide a reliable and secure energy supply as an alternative to grid extension or as a supplement to grid-provided power. Over 400 million people in India, including 47.5% of those living in India's rural areas, still had no access to electricity. Because of the remoteness of much of India's un-electrified population, renewable energy can offer an economically viable means of providing connections to these groups. Some of the renewable energy technologies that are used in villages and rural areas as decentralized systems are:

(i) Family-size biogas plants.
(ii) Solar street lighting systems.
(iii) Solar lanterns and solar home lighting systems.
(iv) Solar water heating systems
(v) Solar cookers.
(vi) Standalone solar/ biomass based power generators.
(vii) Akshay Urja / Aditya Solar Shops
(viii) Wind pumps.
(ix) Micro-Hydro plants.

Many of these systems have been found useful in urban and semi urban areas also to conserve the use of electricity and other fossil fuels. Solar water heating systems have helped in demand side management of electricity in various cities and towns during peak hours. Standalone roof top SPV systems are getting popular for day time diesel abatement in areas where power cuts are very high.

So it can be seen that renewable has a vital role to play in shaping the future of the nation.

Apart from these systems another emerging important area of systems is the micro-grids particularly in rural areas. Because of the remoteness of much of India's un-electrified population, renewable energy based micro-grids either based on single source of based on distributed generation can offer an economically viable means of providing connections to these habitats.

Micro-grid is basically a small-scale power supply network that is designed to provide power for a small community. It can-not be used for high-power consuming devices but can be used as an alternative approach to integrate small-scale distributed energy resources into low-voltage electricity systems. Enabling local power generation, it comprises various small power generating sources that make it highly flexible and efficient. Basically, the solution aims to electrify houses that are not directly connected to the electricity board power grid due to their remoteness.

Renewable energy also has a central place in India's 'Action Plan on Climate Change'.

III RESEARCH, DESIGN AND DEVELOPMENT AREAS

Solar Photovoltaic is a proven technology. Over 4000 MW of power is being generated in the country. But still a lot of RD & D work is still required in this field. Some of the areas are listed below:

(a) Conversion efficiency of solar cells is low. Efforts are being made to develop multi- junction solar cells, dye- sensitized solar cells, polymer solar cells and technology based solar cells. All these are major areas off research today.

(b) The cost of photovoltaic module has been falling steadily worldwide. But due to the cost of the storage devices (wherever used) like batteries, capacitive storage the system cost is still high. Besides batteries need to be replaced periodically which is inconvenient and add to cost. Researchers the world over are working in this area to reduce cost to make it comparable to the cost of conventional power.

(c) Whenever the DC power is converted first for transmission and then in the user's applications there is loss of power. R & D work is on to develop low power and low frequency inverters, DC devices like fans, fridge etc. Some of them are already commercialized but much work is still needed in this direction.

(d) Powered by solar panels micro-grids are spreading slowly across rural India where over 400 million people live without electricity. Nearly all micro-grids in India are powered by solar photovoltaic panels. Intense technical discussion and development efforts are going on in the areas of both AC and DC grids as each has its own merit and demerit. R & D efforts are also being made to develop distributed generation small micro-grids.

IV BIOGAS TECHNOLOGY

It is a common knowledge that most of the energy needs, particularly in domestic activities, in rural areas is met through crop residues, cattle dung and burning of wood. This is a matter of grave concern for all those interested in maintenance of soil fertility, higher crop yield and the environment. The animal waste from livestock population in rural India contributes excess nutrients, pathogens, organic matter, solids and odorous compounds to the environment and severely affects the water quality.

The animals consume plant biomass in both dry and green forms. The dry fodder consumed is usually in the form of crop straw, residual cereals, pulses and oilseeds that are obtained after the harvesting of crop produced, while in mountain regions and other places grasses from permanent pastures usually form the feed of these animal. Biogas is obtained from the animal waste after it is subjected to anaerobic digestion in the digesters. Inside the biogas plant, the complex organic polymers, primarily carbohydrates, lipids and proteins in the biomass, are fermented to produce biogas which mainly comprises methane and carbon dioxide.

A biogas plant (Plate-1) is a set –up device that converts fermentable organic matter into a combustible gas and mature organic manure.

Fig. 2: A Biogas plant installed by Mr. Jay Shankar, Gram- Taiteri, District –Begu Sarai, Bihar

It works by subjecting the material to microbial decomposition in the absence of air, yielding finally, methane, carbon dioxide and water. This process is called anaerobic decomposition. Biogas obtained through this process is known by several names like the swamp gas, sewer gas, fuel gas, marsh gas or wet gas, and in India, it is more commonly referred to as *gobar gas*.

Biogas production is a biochemical process occurring in stages during which different bacteria act on the organic matter. The three stages involved are hydrolysis, acidification and methane formation.

But biomass and cattle –dung are renewable sources of energy. There are several processes by which power sources are created. These processed are listed below:-

(i) Biological Process - Biogas
- Alcohol Fermentation.

(ii) Thermo –Chemical - Pyrolysis
- Gasification
- Briquetting.

In India cattle dung is the principal substrate used for operating a biogas plant. The combined population of domestic animals in India is about 974.01 million heads, comprising 485 million livestock and 489 million poultry. These animals produce about 1386.23 million tones of animal excreta and dropping annually. Assuming that 75% of the total animal waste is collected and 25% of animal waste is not in usable form due to animal holding pattern and other uses about 693.12 million tones of animal excreta is available per year, which can be used biomethanation. This can generate about 290 x 10^8 m^3 of gas having 188.66 m^3 of methane[2]. The energy equivalent of 1 m^3 of biogas with 60% methane is equal to 4713 kcal, or 0.714 l petrol, or 4.698 kWh of electricity. So we can get a lot of energy from cattle dung.

Besides the cattle dung, organic waste available in the country can be technically used to generate biogas. Annual production of wheat and rice in the year 1999-2000 was 71.78 million tones and 88.55 million tones, respectively, which paved the way for 258 million tones of straw, accounting for about 70% of the crop residue available in India. About 45 million tones of fruit and vegetable waste accumulates each year. A large portion of this biomass remains unutilized and creates a problem of disposal and leads to environmental pollution. Besides the bulky nature of organic residues, their low thermal efficiencies and profuse release of smoke are the other major limitations in the use of these residues economically. In recent years, a number of advanced biogas designs have been developed for treating these wastes and including wastes from food processing industries, sewage sludge, municipal and industrial waste and so on. If all this biomass is taken into account as feedstock, the potential for biogas generation in the country is virtually unlimited.

In addition to the gas yield, the organic manure produced from the biogas plants can meet a substantial amount of the nutrient requirement in the country. In fact this slurry from the biogas plant can be used for vermin composting (Plate-2 &3).

Fig. 3 : Vermi Composting at Gram- Tetari, District –Begu Sarai, Bihar

Fig. 4 : Vermi compost in final form made at Gram- Tetari, District –Begu Sarai, Bihar

According to some estimates the cattle dung to vermin compost yield is in the ratio of 3:1. In cost terms 1 Kg of Cattle dung could be priced at 10 paise and 1 Kg of Vermi compost at Rs. 7 to 10. The cost of biogas plant can thus be recovered by sale of vermin compost and biogas may be in two years times or so.

Thus, biogas technology has the potential to address the pressing social, environmental and economic problems in rural areas. It can mitigate drudgery of women and stop soil erosion. The vermin compost in the field results in better nitrogen fixation and water retention and thus preserve the nutrients in the soil. Better environment ensure better health and reduced loss of man hours. The water borne diseases are also drastically reduces due to the availability of clean water. Rain water harvesting could be resorted to and thus protecting the ground water resource. Therefore biogas technology offers a wide scope in rural areas of India.

V RESEARCH, DESIGN AND DEVELOPMENT AREAS

Though biogas is a well proven technology and has found wide acceptance special at family level. However a number of issues are attracting attention of the scientists and technocrats alike. Some of the areas of research, design and development are listed below.

(a) Improvement in process in terms of yield.

(b) Continuous availability of fixed amount of gas,

(c) Reducing the biomethanation time by use chemical methods adopting technologies like genetics engineering and nanotechnologies etc.

(d) Development of Efficient and easy filtering processes,

(e) Scaling up the technology to community level plants and development of technologies for storage like bottling and setting up demonstration plants.

(f) Microbiological studies for use biogas slurry for production of fish.

(g) System design and application biogas for *Atta Chakki* and irrigation pump to make village diesel free.

Under the provisions of technology demonstration MNRE, Government of India took up bottling of biogas to demonstrate on Integrated Technology Package in Entrepreneurial mode on medium size mixed –feed biogas fertilizer plant (BGFP) for generation, purification/enrichment, bottling and piped distribution of biogas[3].

VI RESEARCH & DEVELOPMENT BY THE MINISTRY OF NEW AND RENEWABLE EERGY (MNRE), GOVERNMENT OF INDIA

MNRE supports R & D towards technology development and demonstration leading to commercialization apart from strengthening the capacity of R & D/ academic institution and industry for taking up advanced research for technology development. The ultimate goal is to reduce the cost and improve the efficiency in near future.

A Research, Design & Development Project Appraisal Committee (RDPAC) has been constituted under the chairmanship of Secretary, MNRE for the purpose of giving guidance to the overall direction of RD&D effort in new and renewable energy. This Committee also elicits RD&D proposals, appraises them, and recommends financial support wherever required.

VII SUSTAINABLE RURAL DEVELOPMENT

Energy is an essential input to economic development. India is basically an agricultural country where it's 60% population lives. However the agricultural sector consumes only 14% percent of electrical energy generated in the country. This results in inefficient use energy resources and use of diesel both of which cannot reduce poverty and result in environment degradation.

Further, increased population demands increased production which requires mechanization and hence energy consumption. Therefore, the major challenge for sustainable rural development is energy sustainability. The National Committee of Science and Technology on Fuel and Power indicates the large towns and cities with population of 500000 and more accommodate only 6% of India's total population but consume about 50% of the total commercial energy produced in the country. Therefore, energy demand in rural areas met through renewable energy in an efficient manner alone can ensure sustainable development and solar photovoltaic and biogas are the two such major technologies.

VIII CONCLUSION

Solar power and Biogas technologies hold promise of transforming the rural India and provide sustainable development. Faculty members and students of universities R & D institutions and industry can play a role in this effort by way of their research, design and development efforts. This will also help the country in reducing the emission of greenhouse gases, conserve resources and sustain socio –economic growth.

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Faculty Enrichment through Research Practices: Challenge for the Self-Financed Technical Institutions in India

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I INTRODUCTION

Owing to financial constraints, lack of job security and limitation in facilities, teaching job in private or self-financed institutions is not being a preferred option by the job seekers willing to enter into academic profession. Even then, most of the people engaged in teaching profession are attached with the private institutions producing 90% of graduates in engineering and management. Therefore, there is a great concern about the quality of teaching in the huge mass of teachers many of whom lack the passion which is the fundamental requirement in teaching profession. Teachers are required to enhance knowledge base through continuous process by enriching themselves with new teaching learning pedagogy, state of the art technology and their evolution, match and marry theory with application leading to research. This is only possible when the teachers get proper environment, facilities and infrastructure apart from self-motivation and passion for mastering the art of teaching.

II RESEARCH CHALLENGES IN PRIVATE INSTITUTIONS

There are specific challenges for the teaching faculty in most of the private or self-financed institutions. Lack of fund for experimental research is one main concern. It is in general, difficult to get research grant in the private institutions. For any research, software tools required are in general are costly and the management may not agree to invest that amount for single or handful of researchers unless it is useful for general purpose keeping in mind the poor faculty retention rate. This is true for hardware equipment also. Hence, non availability of advance equipment/testbed (which is supposed to be costly) is another concern. Decline in the number of student's admission is a serious concern to the financial affordability of the private institutions to support costly research facilities. Another important concern is the lack of dedicated, motivated and sincere faculty in most of the private institutions.

Apart from the physical resources, there are other important and practical issues which pose challenge to the research faculties. For example, d*ifficulty in getting eligible supervisor* is a common issue. Even if available, getting registered in the university is very difficult unless the faculty has any personal source. Moreover, in many institutions, there is lack of incentive from the management to motivate a teacher to carry out research in particular, when there is discriminating attitude by the government institutions, funding agencies and regularity authorities towards the private institutions for grant of research fund. Finally, there is a lack of awareness on proper research practices among the fresher's joining in the teaching profession.

III RESEARCH METHODOLOGIES

Research is the systematic approach of collecting information (data) and logical analysis of them applying scientific tools and methods to obtain new findings that leads to a meaningful contribution to the society. It is a combination of investigation of past work and outcome of work in the present that will help others in the future and generate a better solution to the problem. Research shows its best with the combination of imagination, initiative, intuition, critical thinking, common sense and curiosity.

(a) The primary objectives of research [1] are to
(b) Discover new facts
(c) Verify and test important facts
(d) Analyze an event or process or phenomenon to identify the cause and effect relationship
(e) Develop new scientific tools, concepts and theories
(f) Find solutions to scientific, nonscientific and social problems and
(g) Overcome or solve the problems occurring in our everyday life.

- Three research paradigms are
- Scientific
- Interpretive
- Critical

Scientific Methods in Research involve scientific investigation through collecting information (data) in a systematic process and logically analyzing those.

Interpretive methods of research start from the position that our knowledge of reality, including the domain of human action, is a social construction by human actors and that this applies equally to researchers. Thus there is no objective reality which can be discovered by researchers and replicated by others, in contrast to the assumptions of positivist science.

'Critical research' is not a tidy, clearly defined category of research but represents many different types of research. We used to identify approaches that challenge orthodox approach through out of the box thinking.

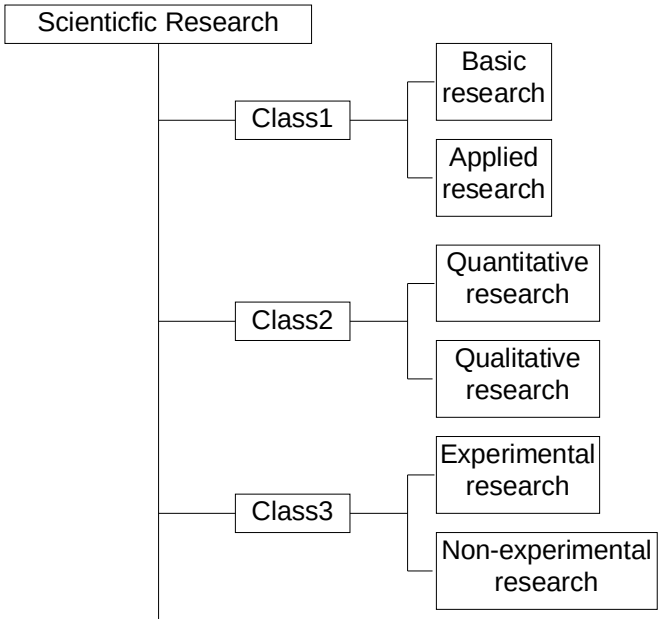

Fig 1 Research classification

Basic research is driven by a scientist's curiosity or interest on nature problem. The main motivation is to expand man's knowledge, not to create or invent something. There is no obvious commercial value to the discoveries

Applied research is designed to solve practical problems of the modern world, rather than to acquire knowledge just for knowledge's sake. Quantitative Research options have been predetermined and a large number of respondents are involved. By definition, measurement must be objective, quantitative and statistically valid. Qualitative Research is collecting, analyzing, and interpreting data by observing what people do and say. Whereas, quantitative research refers to counts and measures of things, qualitative research refers to the meanings, concepts, definitions, characteristics, metaphors, symbols, and descriptions of things. Qualitative research is much more subjective than quantitative research.

Experimental research requires infrastructure to carry out the experiment. Quantitative and qualitative research depends on the experimental research as the qualitative and quantitative measurements based on the designed prototype in experimentation. Self financing institutes in India lacks research infrastructure and they motivate the faculty to do in house research to complete PhD. On the other hand, basic research requires indefinite time to get the outcome. These constraints force the researchers to do applied research or non experimental simulation based research. Simulation is an important component to of research in science and engineering. Its results must be supported and validated by mathematical analysis. Simulation is necessary only to complement mathematical analysis where closed loop solutions are intractable. Simulation parameters must be decided and chosen properly. The output graphs and results must be realistic and within the expected range. All assumptions taken in the simulation must be spelt out properly with their effects in the results.

IV RESEARCH OUTCOME

Outcome of the research is new theory (for basic research), new model (for experimental, quantitative and qualitative research). This outcome can be protected through publication in scientific journal or through intellectual property right (patent). The paper cannot be published before the patent is granted. Patent process in India takes longer time (2-5 years) then the patent process in USA but the patent processing fee in US

is higher than in India. Publishing a paper in SCI indexed journal takes 2-3 years. So the faculty prefers to publish the research outcome rather than filing patent.

IPR protection of research outcome:
Government is changing its policy by emphasizing more on filing patents rather than publishing paper. There are several government agencies and programs are there to support financial and technical assistance to Indian researchers in protecting innovation, commercialization and patent filing like

(a) India Innovation Growth Program
(b) Millennium Alliance
(c) TIME IS
(d) GITA(Global Innovation and Technology Alliance)
(e) NSTEDB(National Science & Technology Entrepreneurship Development Board)
(f) Business Incubator Association ISBA (provide technical support only)

Moreover, several industries like CSIR TECH, Venture capital are there to finance an innovative project on a partnership basis.

V RESEARCH PUBLICATIONS

Research paper indicates academic as well as research excellence of an academician. Ideal research paper contains 90% results and10% presentation whereas common research paper contains 10% results and 90% presentation. Researchers should stay aloof from plagiarism and fake journals. Even self- plagiarism is also injurious for citation count. Now-a-days, good conferences and SCI indexed journal check the papers initially through software for plagiarism before reviewing. There are mushrooming of so-called "open" journals with no pedigree attracts budding researcher to publish their valuable research work. Researchers should avoid such journals. Thomson Reuter maintains a rank based on the merit of the journals. Researchers can refer the list to publish their paper.

But when a faculty joins a self financing institute; pressure comes to them to do research, and publish paper. Level of their research is analyzed through number of publications in national/international journals or in national/international conferences. Due to this objective, the research becomes just to
(a) Publish more number of papers

(b) Get a research degree (Ph.D.) along with its benefits like better employment, promotion, increment in salary, etc.

Unlike the research work done in premier institutions like IIT's or IISc where fundamental results are brought out in the form of patents, commercialized products and very few number papers in the SCI indexed journals. Change in objectives of research changes the paradigm of research. Researchers try to find a problem which can be solvable in a heuristic approach with some result. Publish the result in a journal or conference without bothering whether the results can make an impact to the society or it can be used by the industry in a commercially viable way. Most of the post publication "research" papers, though archived, are hardly read by anybody, including the authors themselves. Even the authors sometimes don't remember the titles of their own papers once the purpose is solved. Most of the research works in India are out of academic compulsion rather than research penchant. It's either to supplement one's career or for better job opportunities.

VI QUALITY MEASUREMENTS IN RESEARCH UBLICATIONS

Research quality is more important that research quantity, i,e just the number of publications. Quality is measured with parameters such as:

(a) ISSN-is a unique 8-digit number -electronic serial of a periodical or publication without any bibliographic description.─Print ISSN (p-ISSN) /electronic ISSN (e-ISSN) identifies just a title without any other significance.

(b) Citation - is the process of acknowledging or citing the author, year, title, and locus of publication (journal, book, or other) of a source used in a published work. For example, references in a paper add citation number. Such citations can be counted as measures of the usage and impact of the cited work to assess the value of a researcher's output. This is called citation analysis or *bibliometrics. ISI citation* indexes are published by Institute for Scientific Information (now part of Thomson Reuters) the in print and electronic form against subscription. Elsevier publishes *Scopus* indexing for citation. *Cite Seer* and *Google Scholar* citations are freely available online. *Indian Citation Index* published online for the peer reviewed journals published from India.

(c) Indexing (h,g,I etc)-

(i) ***h/g* indexes** are the quantitative measures to assess the value of a researcher's output. It does not count the number of papers. It can be measured using the free software "Publish or Perish" (http://www.harzing.com/pop.htm).

(ii) (***h*-index** measures both the productivity and impact of the published work of a scholar. It is based on the set of the scientist's most cited papers and the number of citations that they have received in other publications. A scholar with h-index equal to "*n*" has published at least "*n*" papers each of which has been cited in other papers at least "*n*" times.

(iii) The ***g*-index** - suggested in 2006 by Leo Egghe for quantifying scientific productivity based on publication record and is calculated based on the distribution of citations received by a given researcher's publications:
Given a set of articles ranked in decreasing order of the number of citations that they received, the g-index is the (unique) largest number such that the top g articles received (together) at least g^2 citations

(iv) **Impact factor** - was devised by Eugene Garfield- founder of the Institute for Scientific Information (ISI), now Thomson Reuters. It refers to the average number of citations counted in a year for articles published in a journal in the previous two years - how frequently peer-reviewed journals are cited by others in a particular year. It evaluates a journal's relative importance, compared with others in the same field. Publication in a journal with high impact factor increases citation count and hence higher *h/g*-index. Impact factors are calculated yearly for those journals that are indexed in Thomson Reuters *Journal Citation Reports.* It is based on a three-year period, average number of times published papers are cited up to two years after publication. For example, the impact factor for a journal in 2014 would be calculated as follows:

A = the number of times articles published in 2012-2013 were cited in indexed journals during 2014

B = the number of articles, reviews, proceedings or notes published in 2012-2013.

Impact factor in 2014 = A/B
The value of the impact factor cannot be compared among different scientific disciplines. Microbiology journals have much higher Impact Factors than Mathematics or Engineering journals. The citation patterns in these disciplines are entirely different, therefore the numerical values of their Impact Factors also differ significantly and comparisons would not yield appropriate results.

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Radioisotopes for diagnosis and treatment: Recent trends and path forward

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I INTRODUCTION

Nuclear energy can light up the country by providing electricity. But also be used in a variety of other field including health care to prevent, diagnose and treat disease. Application of radioisotopes (RI) in health care constitutes one of the most important peaceful uses of atomic energy. To day, over 8,00,000 patient investigations are carried out annually in India spanning over 500 centers using radiopharmaceuticals. As far as radiation therapy is concerned, there are more than 300 radionuclidic therapy units operating in over 220 radiotherapy centers in India.

II RADIOISOTOPES

(a) Why radioisotopes - Radioisotopes are used because of the penetrating and ionizing characteristics of the radiations emitted from decaying atoms. Radiopharmaceuticals are substances that are localize in specific organs or tissues. They emit gamma rays that can pass through tissue and can be detected externally by special types of cameras: gamma or PET cameras. For therapy, radiopharmaceuticals delivered a high dose of radiations, specifically to the targeted tumor. A therapeutic radiopharmaceutical emits particulate radiation that typically travels short distances in body tissues, where it either destroys or damages the surrounding cells in the area to which it has distributed.

(b) Classifications - Medical application of radioisotopes and radiation can be broadly classified into two categories including radiopharmaceutical and radiation therapy. A radiopharmaceutical is a radioactive compound which, when administered for the purposes of diagnosis or therapy, elicits no physiological response from the patient. Radiation therapy involves the use of ionizing radiation to destroy cancer cells. The aim of radiation therapy is to impart specific amounts of the radiation at tumors or parts of the body where there is/was disease. Since cancers can occur anywhere in the body, a wide range of equipment is necessary for optimum management.

III RADIOPHARMACEUTICALS

(a) Characteristics - Radiopharmaceuticals, as mentioned above are radiolabelled molecule that exhibit desired biological behavior, either for diagnosis or therapy. If brief they can be considered to be composed of

- a radionuclide
- a carrier molecule (proteins, antibodies, inorganic, organic compounds).

In diagnosis, a radiopharmaceutical containing a radionuclide is administered to a patient and the radiopharmaceutical accumulates in a biological tissue or organ that it is selectively targeted. The organic or biological substrate to which this radionuclide is attached is designed to favor the accumulation of the administered radiopharmaceutical in the targeted cell, tissue, or organ. The radiation emitted from the accumulated radioactivity will then be detected by external measuring devices such as a gamma camera or positron emission tomography to reconstruct to images for diagnostic purposes. For therapy, a cytotoxic level of radiation dose is delivered to disease site by the decaying radionuclides in the radiopharmaceuticals accumulated in the disease site. The diagnostic imaging technique, also called scintigraphy, is performed with radiopharmaceuticals labeled with γ-emitting radionuclides. The physicochemical properties of certain radionuclides allow their use for a therapeutic purpose, based on the ability to deliver cytotoxic level of radiation dose due to the ionizing radiation emitted by the labeled substance. When these vectors are used in association with therapeutic radionuclides, essentially β- or α-emitters, this is described as vectorized or metabolic radiotherapy.

The ideal radiopharmaceutical should:

(i) Emit radiation at a desirable energy level.
(ii) Have a short half-life
(iii) Have high location selectivity.
(iv) Be easy to prepare.
(v) Be inexpensive.
(vi) Exhibit no toxicity.

(b) Mechanisms of localization of radiopharmaceuticals- The mechanism of localization of a radiopharmaceutical in a particular target involves one of the following:

(i) Active Transport: This is the metabolic pathway in the body for moving a radiopharmaceutical across a cell membrane and into the cell. $Na^{123}I$ for thyroid imaging.

(ii) Phagocytosis: This involves physical entrapment of colloidal particles by Kupffer cells in the RE System. Example: ^{99m} Tc- sulfur colloid for liver/spleen imaging.

(iii) Capillary blockade: This involves the intentional microembolization of a capillary bed with particles which offer the scope for external visualization of the perfusion of this capillary bed. Example: ^{99m} Tc-MAA for pulmonary perfusion imaging.

(iv) Cell Sequestration: Injection of damaged RBC's to produce a spleen scan with no visualization of the liver. Example: heat damaged autologous ^{99m}Tc-RBC's.

(v) Simple/exchange diffusion: a mechanism whereby a radiotracer diffuses across cell membranes and then binds/attaches to a cell component. Example: $Na^{18}F$ for bone imaging.

(vi) Compartmental Localization: placement of a radiotracer in a fluid space and imaging of that fluid space. Example: ^{99m}Tc-HSA for MUGA's, ^{111}In-DTPA for cisternograms, ^{133}Xe gas for pulmonary perfusion.

(vii) Chemisorption: surface binding of radiopharmaceutical to a solid structure, e.g., ^{111}In-platelets bound to surface of an active thrombus.

(viii) Antigen/antibody reaction: uptake at tumor site due to specific binding of radiolabeled antibody to surface antigens on tumors.

(ix) Receptor-binding: binding of radiopharmaceutical to high-affinity receptor sites. Example: ^{68}Ga-octreotide for localization of neuroendocrine and other tumors based on binding of a somatostatin analog to receptor sites in tumors.

IV DIAGNOSTIC RADIOPHARMACEUTICAL

(a) Role- Diagnostic radiopharmaceuticals provide information about the functioning of a person's specific organs to make a quick, accurate diagnosis of the patient's illness. The thyroid, bones, heart, liver and many other organs can be easily imaged, and disorders in their function revealed. They play a critical role throughout every phase of disease, including:

(i) Diagnosis and staging
(ii) Treatment planning
(iii) Monitoring response to therapy
(iv) Monitoring for recurrent/residual disease

(b) Properties of the ideal diagnostic radiopharmaceutical

(i) Pure gamma emitter:The radioisotope should be a pure gamma ray emitter, decaying by either electron capture or isomeric transition.

(ii) Energy of Gamma Rays: 100 < gamma energy < 250 keV.

(iii) Effective half-life: Ideally, a radiopharmaceutical's effective half life equals approximately 1.5 times the duration of the diagnostic procedure.

(iv) Photon Abundance: As high as possible.

(v) High Target to non-target ratio: 5:1 minimum for planar imaging, about 2:1 for SPECT imaging.

(vi) Easy Availability and inexpensive.

(vii) Patient safety: The radiopharmaceutical should exhibit no toxicity to the patient.

(viii) Simple preparation and Quality Control

Most radiopharmaceuticals used in diagnostic nuclear medicine procedures emit gamma radiation and have relatively long physical half-lives. The amount of activity required for the formulation of radiopharmaceutical used is carefully chosen to provide the least amount of radiation exposure to the patients, but at the same time ensure an accurate test. Localization of gamma rays emitted by single photon-emitting radiotracers is accomplished by an Anger scintillation camera (gamma camera), which converts the gamma rays to light photons via sodium iodide scintillation detectors. Images of the bio- distribution of injected diagnostic radiopharmaceutical in the body can be acquired using a gamma camera to obtain information about the function of tissues. There are several techniques of diagnostic nuclear medicine. The word "Scintigraphy" ("scint") refers to all the two-dimensional nuclear medicine imaging techniques. Such 2D images, known as planar scintigrams, are degraded by the superposition of non-target activity from the 3D body which restricts the measurement of organ function and prohibits accurate quantification of that function. Computer processing of scintigrams can increase the accuracy with which the image approximates the activity distribution, selectively enhance normal or abnormal structures of interest and optimize the use of the display system presenting the image. "SPECT" is a 3D

tomographic technique that uses gamma camera data from many projections and can be reconstructed in different planes. "Positron emission tomography" (PET) uses coincidence detection to image functional processes.

For medical diagnosis applications the workhorse isotope is ^{99m}Tc which is is obtained from radionuclide generator containing ^{99}Mo owing to its suitable half life (~ six hours), readily available in the form of ^{99}Mo/^{99m}Tc generator; extremely convenient for use in hospitals, gamma ray energy 140keV which can be detected with high efficiency, decay by "isomeric transition" with emission of single gamma rays and low energy electrons and have versatile chemistry. Some of the technetium labelled compounds and their clinical uses manufactured and supplied by BRIT are shown in Table:1.

Table-1
Technetium labelled compounds and their clinical uses

Radiopharmaceutical	BRIT Kit Code	Short form	Clinical Use
^{99m}Tc-Phytate	TCK-16	^{99m} Tc-Phy	Liver imaging
^{99m}Tc Sulphur Colloid	TCK-5	^{99m}TcS/C	Liver and spleen imaging
^{99m}Tc Mebrofenin	TCK-39	^{99m} Tc-mebro	Hepatobilliary function
^{99m}Tc Methylene di Phosphonate	TCK-30	^{99m}Tc-MDP	Bone Scan
^{99m}Tc Red Blood Cells	TCK-38	^{99m}Tc-RBC	Cardiac Function and Blood Pool Scans
^{99m}Tc Mibi	TCK-50	^{99m}Tc-MIBI	Myocardial Perfusion (Heart Muscle Blood Flow)
^{99m}Tc Diethylene Triamine PentaAcetic Acid	TCK-7	^{99m}Tc-DTPA	Renal Function
^{99m}Tc Ethylene di cysteine	TCK-43	^{99m}Tc-EC	Renal tubular function
^{99m}Tc Glucoheptonate	TCK-15	^{99m} Tc-GHA	Kidney imaging
^{99m}Tc Ethyl cystienate dimer	TCK-42	^{99m}Tc- ECD	Brain Scan and Scans for Infection

Table 2
Principal radionuclides used in diagnostic radiopharmaceuticals

Radionuclide	*Symbol*	*Half-life*	*Mode of decay*	*Energy of gamma(s) (keV)*
Technetium-99m	^{99m}Tc	6.01 h	isomeric transition	141
Iodine-123	^{123}I	13.27 h	electron capture	159
Indium-111	^{111}In	67.31 h	electron capture	171, 245
Gallium-67	^{67}Ga	78.27 h	electron capture	91, 93, 185, 209, 300

Positron Emission Tomography (PET) is a specialised nuclear medicine procedure that uses positron emitting radiolabeled tracer molecules to measure biological activity. The more commonly used positron-emitting radionuclides are listed in table 2, and it can be seen that many of them are either directly biogenic or can be easily incorporated into naturally occurring biological substances. To date, the most widely used PET tracer has been ^{18}F-fluoro-deoxyglucose (FDG). This substance is taken up into cells using the same mechanism as normal glucose, but once in the cell, it cannot be further metabolized and remains trapped there. ^{18}F-fluorodeoxyglucose (^{18}F-FDG) is used to determine abnormal glucose metabolism in tumours and other sites. It has general applications in all areas where abnormal glucose metabolism may be present including in circumstances such as differentiating the tumour from scar tissue; evaluating the presence of the tumour in light of rising tumour markers and normal morphological imaging techniques; and assessing response to therapy where other techniques are deemed to be unhelpful. PET images of physiology can also be used to detect pathological changes well in advance of other diagnostic imaging procedures, or a combination of other test.

Table: 3
Positron-emitting radionuclides using in PET imaging.

Radionuclide	Half-life(min)	Maximum positron energy (MeV)
^{11}C	20.3	0.96
^{13}N	9.97	1.19
^{15}O	2.03	1.70
^{18}F	109.8	0.64

BARC along with BRIT operates the 16.5 MeV Medical Cyclotron recently set up in Radiation Medicine Centre (RMC), Parel, Mumbai producing special radiopharmaceuticals like ^{18}FDG for Positron Emission Tomography (PET) studies and supplies are already being made to Hinduja Hospital and Bombay Hospital apart from in-house requirement of RMC.

(c) Therapeutic radiopharmaceutical- Therapeutic radiopharmaceutical is designed to deliver therapeutic doses of ionizing radiation to specific disease sites for cure, disease control or pain palliation. The ionizing radiation induces irreversible damage to the DNA molecule inside the cell, thereby stopping these cells from continuing to grow and divide. In radionuclide therapy, the biological effect is obtained by energy absorbed from the radiation emitted by the radionuclide. Therefore, a radionuclide used for targeted therapy must emit particulate radiations which have relatively short path length thereby depositing the radiation energy in a small volume of cells.

Radionuclides used for targeted therapy should decay by alpha, beta or Auger electron emission. Within each category of these radionuclides, there are multiple radionuclides with a variety of tissue ranges, half-lives, and chemistries which offer the attractive possibility of optimizing targeted radionuclide therapy to the needs of an individual situation. Unlike tumor-directed drugs and toxins, which kill only the directly targeted cells, a unique feature of radionuclides is that they can exert a 'bystander' or 'crossfire' effect, potentially destroying adjacent tumor cells even if they are not targeted by the radiopharmaceutical. A systemically administered targeted radiotherapeutic agent has the potential to eliminate primary tumor site as well as metastasis and other malignant cell populations undetectable by diagnostic imaging.

(d) Properties of the ideal therapeutic radiopharmaceutical

(i) Particle emitter such as β or α with a small γ component for dosimetric purpose.
(ii) Medium/high energy (>1 MeV).
(iii) Half life in days.
(iv) High target: non target ratio.
(v) Minimal radiation dose to non target organ in patient and Nuclear Medicine personnel
(vi) Safety for administration & non toxicity.
(vii) Inexpensive, readily available radiopharmaceutical.
(viii) Simple preparation and quality control requirement if manufactured in house

(e) Types- The efficacy of a therapeutic radiopharmaceutical depends on the radiotoxic nature of the radionuclide and the targeting ability of the vector used for carrying the radionuclide to the proliferating sites. Therapeutic radiopharmaceuticals currently used for treatment of various types of diseases are as follows.

(i) **Thyroid cancer:** Use of iodine-131 for the treatment of thyroid cancer patients is a key example of the early and most successful radionuclide therapy. It is far too quickly forgotten that the successful therapy of thyroid cancers is inconceivable without the use of iodine-131. More than 90% of cases of this cancer are treated and definitively cured with this nuclear medicine method, and this has been the case for the past fifty years.

(ii) **Neuroendocrine Tumors (NETs) using ^{131}I-mIBG:** Metaiodobenzylguanidine (mIBG) is a catecholamine analogue similar to noradrenalin, which accounts for the uptake of this radiopharmaceutical in catecholamine storage vesicles. Use of mIBG labeled with^{131}I is useful to image as well as treat sympatomaticmedulla neoplasms, such as neuroblastoma and pheochromocytoma.

(iii) **Bone pain palliation therapy:** Bone metastasis is a common complication in cancer patients who endure severe bone pain. Bone metastases may occur in almost all tumors at different frequencies, however, prostate, lung, and breast cancer have maximum chance for metastasis. Radiopharmaceutical treatment of metastatic bone pain has emerged as an effective modality that provides palliation

of pain to multiple areas of the skeleton simultaneously without the significant soft-tissue toxicity. The radionculides used and proposed for bone pain palliation have wide ranging nuclear characteristics such as half life, decay energy, availability of imageable photons etc.

(iv) **Radiosynovectomy:** Radiosynovectomy or radiosynoviorthesis is defined as the restoration of inflamed and damaged synovial membrane of the joints after intra articular injection of radionuclide based preparations. In this procedure, a beta-emitting radionuclide in colloidal or particulate form is injected into the articular cavity in which they are phagocytized by the outermost cellular layer of the synovial membrane and deliver radiation dose to the synovium without excessive irradiation of surrounding tissue.

V TREATMENTS

(a) Treatment of hepatocellular carcinoma (HCC) and hepatic malignancies: Hepatocellular carcinoma (HCC) is a malignant tumor of the liver hepatocyte. It may present either as primary liver cancer or as secondary liver tumors. Radioembolization is one of the intriguing therapies for the treatment of liver malignancies for administering radiotherapy internally to provide the cytotoxic radiation dose. The technique of trans-arterial radio-embolization exploits HCC preferential blood supply from the hepatic artery to deliver the radioactive particles which end up in hepatic end-arterioles, allowing localized delivery of therapeutic doses, while sparing the surrounding liver parenchyma. Thus, it is essentially a flow-directed mode of treatment that is dependent on neoangiogenesis. In this modality, ^{131}I or ^{188}Re labeled lipiodol, ^{90}Y or ^{166}Ho labeled microspheres/particles are some of the radiopharmaceuticals that have been extensively studied.

(b) Peptide receptor radionuclide therapy (PRRT): Neuroendocrine tumors (NETs) are relatively rare tumors, mainly originating from the digestive system, able to produce bioactive amines and hormones. These cells are able to synthesize, accumulate and secrete numerous bio-active molecules acting like neurohormones, neurotransmitters and neuromodulators. NETs tend to be slow growing and are often diagnosed when metastatic. Peptide receptor radionuclide therapy is an effective treatment option for patients with well-differentiated somatostatin receptor-expressing neuroendocrine tumors. NETs usually over-express somatostatin receptors, thus enabling the therapeutic use of somatostatin analogues, one of the basic tools, able to reduce signs and symptoms of hormone hypersecretion, improve quality of life, and slow tumor growth. The peptides 1,4,7,10-tetraazacyclododecane-1,4,7,10-tetraacetic acid (DOTA), Tyr3-octreotate (DOTATATE) and DOTA, Tyr3-octreotide (DOTATOC) (brand name Onalta), predominantly targeting sst2, have been granted Orphan Drug status by the European Medicines Agency and the US Food and Drug Administration for application in PRRT. Peptide receptor radionuclide therapy (PRRT) with somatostatin analogues ^{90}Y-DOTATOC and ^{177}Lu-DOTATATE has emerged as the effective modality of treatment which demonstrated impressive results on tumor response, overall survival, and quality of life in patients with gastroenteropancreatic neuroendocrine tumors. Besides somatostatin receptor-targeting peptides, multiple other radio peptide analogs were developed targeting several other receptors overexpressed on various tumors. Some of these peptide analogs, including cholecystokinin, gastrin, gastrin-releasing peptide, arginine-glycine-aspartate (RGD)-peptides, and glucagon-like peptide analogs appeared very promising in preclinical and clinical imaging and PRRT studies.

(c) Radioimmunotherapy (RIT): Radioimmunotherapy (RIT) uses monoclonal antibodies as the vector for transport of the radioactivity to cancer cells. The radiolabeled antibodies are directed against various antigens overexpressed on tumor cells or blood vessels formed during angiogenesis. RIT combines the synergistic effects of both radiation and immunotherapy with manageable local and systemic side effects. Beta decay radionuclides have been extensively used for radionuclide treatments and offer better radiopharmaceutical characteristics for design and therapy administration. The unique characteristics of cross fire effect, adequacy of delivery to cell surface added to the ease of labeling, and availability led to widespread use of beta particle radioimmunoconjugates. The improved effectiveness of antibodies labeled with beta emitting radionuclides relates to the phenomenon of “cross fire” or “by-stander” effect, where in the tumor cells within close range of the targeted cell are also, killed secondary to beta ionizing radiation irrespective of the antigen expression.

BRIT produces and supplies a wide range of radiopharmaceuticals to hospitals and medical institutions to enable various diagnostic and therapeutic studies on patients. These products undergo strict, analytical and quality control tests, including sterility pyrogen tests and biodistribution.

VI RADIATION THERAPY

"Radiation therapy" (or "radiotherapy") is the medicine/medical use of ionizing radiation for the treatment of malignant and benign disease. Radiation therapy is used to treat cancer and a few non-cancerous diseases.

(a) Classification- Radiation treatments can be called:

(i) Definitive-to cure,
(ii) Palliative-to treat symptoms, but not cure.

More than half of all cancer patients are treated with radiation therapy sometime during the course of their illness. About half of these are treated for cure, and half for palliation.

(b) The factors, which determine radiation therapy, include

(i) The sensitivity of the tumor to RT,
(ii) the volume of tumor cells to be eradicated and
(iii) The tolerance of the most radiation sensitive vital tissues in the area.

(c) Radiation can be used at different stages of cancer treatment including:

(i) Early stages in an attempt to cure or control the cancer.
(ii) Before surgery to shrink the cancer.
(iii) After surgery to prevent cancer from recurring.
(iv) With surgery or chemotherapy for advanced cancer as an adjunct mode of therapy.

The radiation used for cancer treatment comes either from special machines or from radioactive substances. There are two basic types of radiation therapy. They are external beam radiation therapy (EBRT) or *teletherapy* and internal beam therapy or *brachytherapy.*

(d) External beam radiation therapy (Teletherapy):- With external beam radiation therapy, a machine is used to direct the electromagnetic radiation to the cancer site through the skin. The source of electromagnetic radiation comes from either an electron accelerator (LINAC) or radiation emitted from radioactive elements of isotopes. Majorities of the patients who are treated with radiation therapy are treated with external beam irradiation.

Since cancers can occur anywhere in the body, a wide range of equipment is necessary for optimum management. The treatment machines include linear accelerators, cobalt-60 teletherapy unit, and superficial x-ray machine. External beam therapy can be used to treat the following diseases as well as many others:

(i) Breast Cancer
(ii) Colorectal Cancer (Bowel Cancer)
(iii) Head and Neck Cancer
(iv) Lung Cancer

The radiation therapist brings the patient into the treatment room and places him/her on the treatment couch of the teletherapy machine in exactly the same position that was used for simulation using the same immobilization devices. The therapist carefully positions the patient using the alignment lasers and the marks that had been placed on the patient during simulation. Beams from one or more directions may be used and the beam may be on for as long as several minutes for each field. The treatment process can take 10 to 30 minutes each day and in each sitting normally radiation doses of 2 Gy is given. Patients usually receive radiation treatments once a day, five days a week for a total of two to nine weeks. The total cumulative dose given to the patient will be about 40 -60 Gy. The patient's diagnosis determines the total dose and duration of treatment.

(e) New Evolutions- First developed 85 years ago in England (First teletherapy machine containing 2.5g of Radium was installed at the Middlesex Hospital, London in 1919), advances in technology and a better understanding of its effects on the body have made external beam therapy more refined. As a result, wide varieties of treatments using geometrical shaping and intensity modulation of beams have evolved.

Some of the recent developments are:

(i) Gamma Knife.
(ii) Conformal Therapy.
(iii) Intensity modulated radiation therapy (IMRT).
(iv) Intraoperative radiation therapy.
(v) Postoperative radiation therapy
(vi) Total Body Irradiation (TBI).

BRIT plays a major role in the battle against cancer by supplying cobalt tele-therapy sources to cancer hospitals in the country. To meet the growing demand of teletherapy machines, DRHR of the BARC has developed a computerized telecobalt machine Bhabhatron with the TMC.

(f) Brachythyerapy - Brachytherapy is a word derived from the ancient Greek words for short distance or close (*brachy*) and treatment (*therapy*). The term is generally used to describe the use of radioactive isotopes in the treatment of cancer and benign diseases. This allows for a very high dose of radiation to be given to the cancer while reducing side effects. Brachytherapy implants can be either temporary or permanent, depending on the site being treated and the isotope being used. Patients can also be treated by different strengths of isotopes, where either a low dose of radiation is delivered over several days to months, or a very high does of radiation is delivered in a matter of minutes via a temporary catheter.

A variety of different radioactive sources have been used in brachytherapy. Table.4 gives a summary of their characteristics.

Brachytherapy can be used to treat cancer in different part of the body including breast, lungs, eye, prostate, cervix using wide varieties of apparatus and applicators.

Table 4
Characteristics of radionuclides used for brachytherapy

Radionuclide	Typical form	Typical application	Half life
^{60}Co	pellets	HDR remote after loading	5.27 years
^{125}I	seeds	Permanent or temporary volume implants	60 days
^{137}Cs	needles, pellets, tubes	LDR remote afterloading	30 years
^{192}Ir	hairpin, wires, HDR sources	Interstitial implants, HDR and LDR remote afterloading	74 days
^{198}Au	seeds	Permanent volume implants	2.7 days
^{226}Ra	needles	Not commonly used any more	1600 years

VII CONCLUSION

Radioisotopes play a significant and indispensable role in studying and understanding biological processes, viewing internal biological structures and processes for diagnosis of abnormal conditions, and in cure and alleviation of sufferings of cancer patients. With the availability of large number of diagnostic agents, SPECT and PET are matured technologies and is the mainstay of functional diagnostic imaging. Treatment of cancer with radioisotopes provides effective cure and the palliation of intractable symptoms. In a country like India, where more than 70% patients present in advanced and inoperable stages, radiation therapy plays an important role. While PET has seen the maximum growth in the last 15 years, next phase of growth of nuclear medicine is expected to be in radionuclide therapy. The new imaging modalities that appeared on the market at this very beginning of the new century and the new molecules and therapeutic technologies associated to the radioactivity open a very encouraging window that fascinates experts from other medical disciplines, and more particularly the oncologists, the hematologists and the neurologists. Cancer treatment remains at the forefront of any new therapeutic modality.

Industrial Applications of Radioisotopes in India

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I INTRODUCTION

Production of radioisotopes in India started way back in 1956 with commissioning of 1 MW research reactor named as APSARA. The production capability was augmented in 1963 when 40 MW CIRUS reactor attained its full rated capacity. During the early seventies, a strong need was felt for building another research reactor with higher neutron flux to meet the growing demand of radioisotopes. This led to the setting up of a 100 MW reactor named as DHRUVA. Therefore, the radioisotopeproduction capability was augmented by many folds with commissioning of DHURVA reactor in 1985. Subsequently, the CIRUS reactor, refurbished in 2003, was shutdown on December 31, 2010 after 50 years of successful operation.Today, with the operation of DHRUVA reactor, India is one of the leading producers and suppliers of various radioisotope products..

The applications of radioisotopes and radiation technology in industry, healthcare and agriculture form an important part of India's programme of using nuclear technology for societal benefits. As a consequence of an early realization of importance of radioisotopes and radiation technology, India today has a fairly advanced base for applications of radioisotopes and radiation technology in medicine, industry and agriculture. Board of Radiation and Isotope Technology (BRIT), Department of Atomic Energy (DAE) supplies radioisotopes and radiation equipment to the various users in the country and abroad, and along with the Bhabha Atomic Research Centre (BARC), Mumbai offers professional services to meet the country's demand in various fields of applications. The Bhabha Atomic Research Centre, Mumbai also undertakes R&D programmes for advanced applications. The radioisotope applications in industry are divided into following two categories:

(a) Radiotracer applications
(b) Sealed source applications

Some of the applications are briefly discussed below.

II RADIOTRACER APPLICATIONS

The idea of using tracers for troubleshooting and to investigate flow behavior in chemical process equipment has always attracted attention of engineers and scientists. In radiotracer applications, the radioactive material in a suitable physo-chemical form similar to that of the process material is injected into the system at the inlet and its passage is monitored along the system at strategically selected locations using radiation detectors. The presence of tracer or tracer concentration obtained as a function of time at detection location(s) is plotted and information about occurrence of malfunctions, if any and hydrodynamic behavior of the process equipment are drawn. The commonly carried out radiotracer applications in industry in India of include:

(a) leak detection in buried pipeline and industrial systems

(b) mixing/blending time measurements in batch type systems

(c) flow rate measurements in pipe lines and open channels

(d) residence time distribution measurement and analysis in continuous flow systems

(e) sediment transport investigations in ports

(f) effluent dispersion studies in water bodies

(g) wear and corrosion rate measurements

(h) radioactive particle tracking technique for flow visualization

(i) radiotracer applications in oil fields

Since early sixties, BARC, Mumbai has made pioneering contribution to the development and promotion of radiotracer technology in India and Asia Pacific region for troubleshooting and process optimization in industry. Isotope Production and Applications Division (IP&AD), BARC alone has carried out over 350 field-scale radiotracer investigations to benefit the Indian industry during last four decades.In addition to this, large steel and oil industries have their own tracer groups for in-house applications.BARC is recognized as a centre of excellence for tracer technology in industry in the region of Asia and the Pacific and provided strong support to the RCA/UNDP projects on industrial applications of isotopes and radiation technology since 1982.

III SEALED SOURCE APPLICATION

In sealed source applications, radiation source is encapsulated in a metal capsule and never directly come in contact with either process material or equipment. The penetrating radiation from the radiation source capsule are directed at the desired location in the equipment under investigation or material of interest and the intensity of transmitted or scattered radiation intensity is measured and analyze to draw information about content of the system or physical properties of the material. The sealed source applications in industry can be further divided into following four categories.

(a) Non-destructive testing*(Radiography and Tomography)*
(b) Radiometry/Gamma scanning
(c) Nucleonic control systems
(d) Radiation processing

BARC and BRIT, Mumbai have played a pivotal role in promoting the use of gamma emitting sealed sources for NDT applications in India. Radiography is extensively used as a mandatory requirement in manufacturing of pressure vessels, turbines, space vehicles, aircrafts, ships, bridges, offshore rigs and platforms, transport pipelines and a host of other industrial areas. There has been a phenomenal growth in the number of radiography testing installation in India during last 3 decades. Today, there are over 2800 radiography cameras, 500 industrial X-ray machine and 800 radiography sites in about 500 institutions. Isotope radiography exposure devices housing ^{192}Ir and ^{60}Co sources and with lead shielding are produced in India and are marketed by the Board of Radiation and Isotope Technology (BRIT). Training courses are regularly organized for various cadres of radiography personnel; operators to managers (RT-1 to RT-3). Nearly 10,000 people have so far been trained and licensed to practice isotope radiography technique.

One of the recent developments in the field of NDT in BARC is the building of a industrial computed tomography (ICT) imaging system for cross-sectional examination (3-dimensional) of various objects like reactor fuel assemblies and solid propellants in rocket motors. The first ICT system in BARC was developed using a 7 Ci (260 Gbq) ^{137}Cs source and a NaI (Tl) scintillation detector. The system has been upgraded with an X-ray source and an array of cadmium tungstate detectors.

Gamma scanning is a non-invasive technique used frequently for troubleshooting of industrial process columns. This technique is also employed for debottlenecking studies of processes involving multiphase systems. The technique is so effective that even for predictive maintenance of column hardware, it is frequently used. Basically this technique uses absorption of gamma ray emitting from radioisotopes by process fluids consisting of vapour and liquid. The technique is gradually being used to solve more and more complex problems like misdistribution in packed bed, entrainment from tray columns etc. The international scenario, this technique is exploited on a routine basis and offered as specialized service. Gamma scanning technique has also emerged as a reliable research tool to generate valuable performance data.

Another application of sealed source applications is the Nucleonic Gauging. Indian industry has been using nucleonic gauges for over 4 decades. It is estimated that there are now more than 10,000 nucleonic control systems in about 1850 installations. These include level gauges, well logging systems, thickness gauges, density and moisture gauges, beta scopes and others. The main manufacturer of NCS in India is the Electronics Corporation of India Limited, Hyderabad.

High intensity gamma radiation can impart beneficial changes in materials exposed to it. The source of the high energy gamma radiation is usually either radioactive cobalt-60 produced in nuclear reactors or high energy electron beams from industrial electron accelerator. India produces Cobalt-60 in its research reactors as well as in the nuclear power reactors. Over the years, BARC has developed technology for fabrication of high intensity sources and fro design construction and operation of gamma irradiators for a variety of applications. Some of the common applications of gamma radiation processing include sterilization of medical products, sewage sludge hygienization and vulcanization of natural rubber latex. The radiation processing applications using electron accelerator includecross-linking of wire and cables, coloration of gems and semi-precious stones, degradation of Teflon scrap for use in lubricants etc.

IV CONCLUSIONS

India has fairly advanced infrastructure/facilities and good expertise for applications of radioisotopes in industry. The Bhabha Atomic Research Centre and the Board of Radiation and Isotope Technology have developed the necessary know-how and expertise in the areas of industrial applications of radioisotopes technology. Indian industry has been immenselybenefitted from the application of radioisotope technology. The level of application,

though growing, is still not commensurate with the level of technology development for a country of India's size and economy. With the present trend towards liberalization of economy and the increased awareness of the potential of radioisotope technology in industry, one can safely look forward to increased applications.

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Electron Beam Processing for Industrial Applications

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ABSTRACT
High energy electrons from accelerators-both focused and scanned have been utilized for a number of applications in the fields of medicine, engineering, industry, environmental protection and research. Focused electron beams and bremsstrahlung x-rays are employed mainly in radiotherapy and industrial engineering applications. Scanned beams up to 10 MeV are utilized extensively for irradiating materials on large scale in industry, called as EB processing. High voltage linear accelerators like Cockroft-walton generators, Dynamitron etc. (DC machines) and RF linacs are beneficially used for these applications suitable in terms of robust design, cost and beam characteristics. The associated equipment and irradiation geometry are normally chosen specific to the application. Presently, processing of materials using high energy electron accelerators (200keV-10MeV) constitutes the largest commercial radiation application in the industry. World over, there are over 2000 accelerators operating in the wire/cable, heat shrinkable, surface curing and other related industries. These industrial type accelerators have the ability to deliver high doses at dose rates of the order of 10 kGy s^{-1} (10^{10} - 10^{12} Gy s^{-1} in case of pulse accelerators) as compared to few Gy/s for ^{60}Co gamma irradiators. They can be operated continuously for 24 hours/day and have been in use for on-line processing of wires & cables, films, tyres etc. With the availability of high energy pulse accelerators (5-10MeV) operating at power range of 10-100 kW, coupled with x-ray generation systems, sterilization of medical products has become competitive to present ^{60}Co gamma sterilization.

I ELECTRON BEAM (EB) PROCESS AND PARAMETER EVALUATION

The upper limit in the energy i.e.10MeV for electrons and 7.5MeV for x-ray sources has been imposed for radiation processing applications to ensure that no radioactivity is induced in the irradiated material. The role of EB processing in industry has been growing due to the advantages such as : a) desired chemical / biological changes are induced at room temperature b) a much purer product is obtained since the use of chemical catalysts, initiators, fumigants etc, are eliminated or drastically reduced- hence environment friendly c) process larger throughputs at high dose d) ability to hook up to the industry for existing on-line processing e) energy efficient f) switch on & off type radiation (unlike in gamma irradiators) - hence more safe and wide public acceptance.

The aim of the industrial processing using EB accelerators is to treat large quantity of products to the required dose levels uniformly, at fast line (product conveying) speeds. In industrial accelerators, unlike radiotherapy and engineering applications, the output electron beam is scanned and extracted through a thin foil so that a *line source* is formed. The product is made to pass under it perpendicular to the source. Uniform dose distribution is ensured by proper selection of the electron energy, thickness and product irradiation geometry. Even though the electrons have shallow penetration and has dose distribution (as shown in fig.1), because of the intense sources in the range of 10-500 kW power, it is possible to irradiate larger throughputs at higher doses.

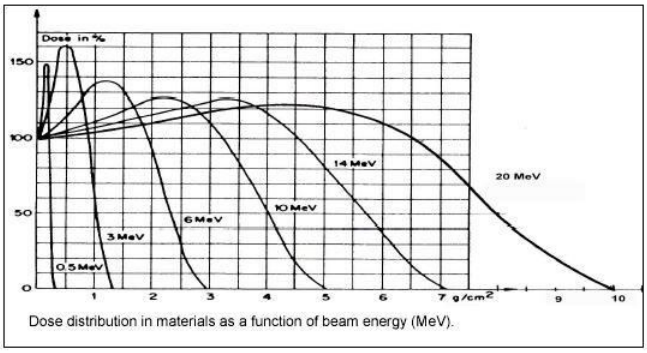

Fig.1 Dose distribution in materials as a function of beam energy

The main accelerator parameters of interest are the electron beam energy and current (beam current in case of DC accelerators; beam pulse & average current in case of pulsed beams). The energy decides the thickness of the product that can be uniformly irradiated while the dose rate at which the product can be irradiated depends upon the current. The thickness R which is called the *useful thickness* is defined as the depth at which the dose equals the surface dose. In order to evaluate this thickness, it is essential to obtain depth-dose curves as shown in figure 2 in the material for different beam energies. The useful thickness can be increased if the product is irradiated from both the sides as shown in figure 3.

A rough estimation of useful (process) thickness can be reached from the formulae given below.

$E = 2.63\ R_\rho + 0.32$ (one-side irradiation)

$E = 1.19\ R_\rho + 0.32$ (two-side or double sided irradiation)

where E is the beam energy and R_ρ is the useful thickness of the material in g/cm^2.

The process throughput T depends upon the beam power P, dose D and the beam utilisation efficiency η, using a suitable irradiation system and is defined in equation

$T(kg/h) = 3600\ P(kW)\ \eta / D(kGy)$

It is necessary to employ different irradiation methods and product transport systems depending upon the nature of products and their shapes and dimensions. Sometimes, it is also necessary to irradiate the product repeatedly to give a cumulative desired dose. For example finished wire/cable insulations are irradiated from both the sides using the ***figure of eight*** conveyor geometry. For bulk processing viz, medical products sterilization, food irradiation etc, carefully packed product boxes can be transported under the beam using linear conveyor with two & fro motion.

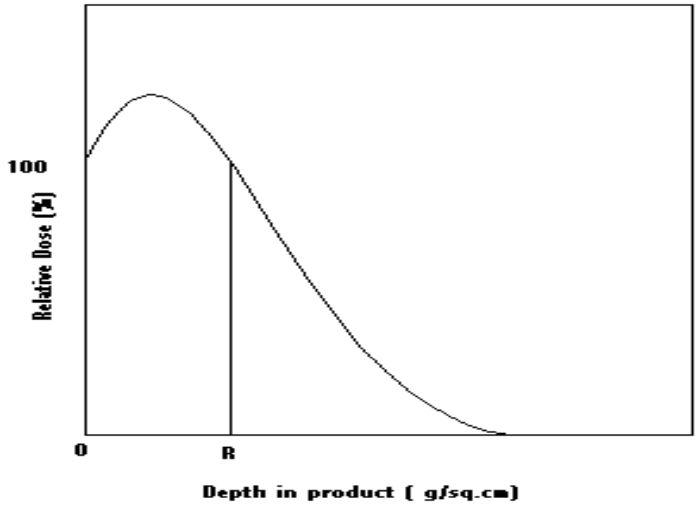

Fig. 2 Typical Depth dose curve for electron beam

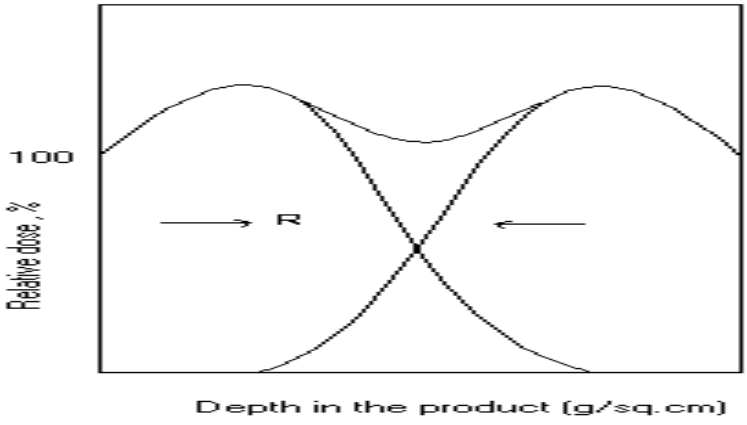

Fig.3 Typical shape of depth-dose curve when irradiated from both sides using electrons

II X-RAY MODE OF IRRADIATION

High energy electrons are made to impinge on heavy targets to produce intense X- rays (bremsstrahlung radiation). This radiation can be beneficially utilized for processing of materials. Studies have shown that such radiation with maximum energy and power, offers better dose uniformity and processing throughputs in comparison to the equivalent power of radioisotope source based irradiator. Thus, the accelerator can be used for high throughputs of thin products in EB mode; and large thick (inhomogenous) products in X-ray mode.

III APPLICATIONS IN ELECTRON BEAM PROCESSING

Different applications with required dose are mentioned in the following table 1. Some of the popular established applications include polymer modifications, color enhancement of gem stones, medical products sterilization. Other emerging applications like waste water treatment; flue gas treatment and food processing are gaining importance worldwide.

Table 1:
Absorbed dose range required for some applications

Application	Dose required (kGy)
Disinfection	0.25-1.0
Food preservation	1.0-25.0
Medical Sterilization	20-30
Curing of coatings	20-50
Polymerization	50-100
Crosslinking of polymers	50-300
De-polymerization of PTFE	400-1000
Coloration of diamonds	~ in MGy levels

(a) Polymer Modifications Using Ebeams- Free radicals are produced when polymers are exposed to ionizing radiation like gamma ray, EB or X-rays. These active species are responsible for initiating chemical reactions leading to modifications like (1) formation of network in polymer chains called cross-linking (2) molecular weight reduction by chain scission called degradation and (3) polymerizing a monomer and grafted onto the base polymer chain called grafting. Simultaneous polymerization and cross linking is also possible as in the case of coatings or composites called as curing. However, the effect is different for different polymers and is intrinsically related to the chemical structures of the polymers. While cross linking is predominant in some polymers, degradation is predominant in others. Polymers with more hydrogen atoms on the side (e.g., polyethylene) tend to cross-link with radiation. Polymers with a methyl group (e.g., polypropylene), di-substitutions (e.g. polymethacrylate) and per-halogen substitutions (e.g., polytetrafluoroethylene) would more likely undergo degradation with radiation. Aromatic polymers with benzene rings either in the main chain or on the side (e.g., polystyrene and polycarbonate) are usually radiation resistant. For some polymers, elevated temperature may increase the mobility of the polymer chains and make it more favorable to cross-linking. Oxygen in the air usually assists the degradation more through a peroxide radical mechanism, so an oxygen-free atmosphere would usually be more favorable for cross linking.

(b) Cross-linking - Cross-linking is the most important effect of polymer irradiation and has the larger number of applications because it can usually improve the mechanical and thermal properties and chemical, environmental and radiation stabilities for both preformed parts and bulk materials. The following are some examples of applications.

(i) **Wire and Cable:** The crosslinking of insulation on electrical wires and cables was one of the first practical applications of radiation processing. Polymers used in this application include polyethylene, polyvinylchloride, ethylene-propylene rubber, polyvinylidene fluoride, and ethylene-tetrafluoroethylene copolymer. Product improvements obtained by irradiation include increased tolerance to high temperature environments and overloaded conductors, fire retardation, increased abrasion resistance and tensile strength, reduction in cold flow,

increased resistance to solvents and corrosive chemicals as well as some other important characteristics. Irradiated wires are commonly used in automobiles, military vehicles, aircraft, spacecraft and many other applications where high performance is required.

(ii) **Heat-Shrinkable Products:** Thin-walled plastic tubing and plastic films are cross-linked to obtain the so-called "memory" effect from the cross-linked network. Radiation cross-linking fixes or stabilizes the original dimensions of the tubing or films. When the material is heated above the temperature where the unirradiated material would melt, it becomes elastic and can be expanded to at least twice its original dimension. When cooled, it maintains the expanded dimension but retains the "memory" of its original dimension. When heated again, it contracts to the original dimension. Polyethylene is commonly used for this application. Many commercial products have been developed. Some examples for tubing products are encapsulations for electronic components, bundles of electrical wires and exterior telephone cable connectors. The applications for films are mainly in the food industry, where heat-shrinkable wrapping material is used to make attractive, sealed packages. Modern packaging films use blends of several different polymers to provide desirable properties like clarity, toughness, oxygen exclusion and moisture retention.

(iii) **Rubber Tires:** Automobile tire tread sections are irradiated to obtain partial cross-linking before the tire is assembled. This stabilizes their thickness during the final thermal curing process. It also prevents the steel belt from migrating through its supporting rubber layer. The result is a higher quality tire with more uniform thickness and better balance. This allows the tire to be made thinner to save material and reduce cost. A thinner tire also generates less frictional heating on the road. Dose requirements are in the range of 30 to 50 kGy.

(iv) **Plastic Pipes:** Cross linked plastic pipes are used to distribute potable hot water and for floor and wall heating applications. The pipe may either be made entirely of polyethylene, or may be a composite pipe consisting of an inner layer of polyethylene to keep the water from contacting a middle layer of thin aluminum, which resists the water pressure, and an outer layer of polyethylene for abrasion resistance. Both the inner and outer plastic layers are irradiated simultaneously with electron beam. Cross-linking enhances the mechanical properties and the thermal stability of the pipes. Plasticized PVC pipes are also cross-linked with radiation.

(v) **Plastic Foams:** Plastic foam is made by mixing a foaming compound with the basic polymer and then heating the mixture to release gas bubbles emanating from a nitrogen-containing foaming agent in the plastic material. Polyethylene, ethylene vinlyacetate copolymer and polypropylene are suitable materials. A typical foaming agent is azodiacarbonamide or nitrogen.

Radiation cross linking allows the use of higher expansion temperatures and simplifies the control of the expansion process. Applications include foamed insulation in coaxial cables, gaskets, coated tapes, floor backing, helmet liners, athletic safety pads, bra cups, automobile seat padding and jewelry case liners.

Orthopedic devices such as hip joints are usually made of ultra high molecular weight polyethylene (UHMWPE). Radiation cross-linking can significantly improve the wear resistance of the surface these devices.

(c) Curing: Curing is a combination of polymerization and cross-linking initiated by radiation from monomers and oligomers. Major advantages of radiation curing include reduction or elimination of volatile organic compounds (VOCs) and faster curing. Radiation curing of coatings, inks and thin adhesives usually only requires low energy electron beams. The following are applications for medium to high beam energies.

(i) **Composite Materials:** Advanced composites, such as carbon fiber reinforced polymer resins, have become very important materials that are used for a wide range of applications because of their excellent mechanical properties and low weight. Conventionally, the composites have been cured by thermal means, which employ autoclaves or ovens and high temperature to accomplish the chemical reactions of curing (i.e., polymerization and cross-linking of the polymer resin). EB curing has many important advantages over the traditional thermal curing, e.g., faster cure time, lower (ambient) temperature curing (which significantly reduces internal stress), capability to cure large parts, simplified tooling, improved material handling, reduced VOC emission and better process control. Typical resins are acrylated epoxies and EB curing may be accomplished with either a free-radical mechanism (no initiator needed) or a cationic mechanism (initiator required). Doses are typically in the range of 100 to 200 kGy. The main potential applications are in automotive and aerospace industries.

(ii) **Adhesive Bonding of Thick Components:** There have already been examples of EB curing of adhesives for the bonding of large composite structures for aerospace and automotive applications. Compared with conventional thermal curing, EB curing of adhesives has many environmental and processing advantages such as reduction or even elimination of organic solvents (VOCs), faster curing, elimination of time constraints (due to the long life of EB-curable adhesives), fewer processing steps, reduced cost, elimination of autoclave/oven processing, reduced residual stress, prevention of de-bonding of dissimilar materials and "spot welding" type of bonding by beaming at specific areas.

(d) Degradation: Some polymers that undergo degradation upon EB processing include polytetrafluoroethylene (PTFE), polypropylene (PP) and cellulose. Although degradation usually brings about deterioration of mechanical properties of polymers and needs to be avoided in many cases (e.g., radiation sterilization), some good applications have been found for chain scission of polymers by radiation.

(i) **Particle Size Reduction for Fine Powders:** A well-known example of applications for degradation is the making of fine PTFE powders. PTFE has a high G value for scission and can be readily degraded to lower molecular weight by radiation. One of the results of the degradation of PTFE is the much higher brittleness of the material. This effect is used to convert scrap PTFE into fine particles or micronized powder. The unirradiated scrap is too tough, doughy and slippery to grind, but the irradiated material can be ground readily.

(ii) **Melt Flow Rate:** Adjustment. Another effect of degradation is the increase of the melt flow rate (MFR) of the polymer. In particular, polymers can be intentionally degraded by radiation in air to improve the process ability for extrusion, etc. Irradiated polymers can be blended with unirradiated polymers to adjust the melt flow and improve the process ability, for example producing a range of MFR for PTFE that it is high enough for the polymer to be melting process able but low enough so that the polymer was is too brittle to process. Irradiated PP can be mixed with unirradiated PP, and the degree of degradation may be controlled so that mechanical properties are not significantly deteriorated, yet melt flow advantages are obtained.

(e) Grafting: Radiation-initiated grafting is known to be a very good method for surface modification of polymer materials. The surface properties of polymers can be modified by graft copolymerization with different monomers. Grafting can be accomplished by irradiation on common polymers such as polyethylene, polypropylene and fluoropolymers. Most work has been done on polymer films, membranes, fibers and natural and synthetic textiles. Examples include grafting of acrylonitrile, maleic anhydride, styrene, N-vinylpyrrolidone acrylic acid and various acrylate monomers on polyethylene and fluoropolymers. Other examples are the bonding of styrene on cellulose, vinyl pyridines on wool and p-nitrostyrene on polyethylene, polypropylene and polyvinyl chloride. Hydrophilic properties can be imparted to hydrophobic polymers. Biocompatibility of various polymers can be improved in this way for medical uses. Ion exchange membranes and fuel cell/battery separator films can be made by grafting styrene onto porous fluoropolymer (e.g., polyvinylidene fluoride) membranes followed by sulfonation.

IV OTHER APPLICATIONS

EB accelerators have been in use for lifetime control studies in semiconductor power devices. The advantages of this technique include precise control of defects through proper dose and dose rate, convenient process, rectification in defect control by annealing and re-irradiation.

Applications viz. Medical products sterilization, food irradiation, decontamination of waste water and sewage are great giants for commercial exploitation using high energy accelerators. Typically a 10 MeV electron accelerator is able to sterilize more than 90% of the medical devices being irradiated using gamma radiation.

(a) Flue gas treatment: Low energy accelerators with high powers are being employed to irradiate SO_2 and NO_x along with CO_2 gases generated in large quantities by industrial power plants in the presence of ammonia to simultaneously remove SO_2 and NO_x gases and convert them into useful fertilizers as a by-product. Pilot scale studies have been completed in USA, Japan, Germany & Poland and industrial treatment plants are being set up.

(b) Colour enhancement in gem stones: Significant color enhancement in the diamonds can be brought out by subjecting them to very intense electron beams, there by inducing defects so that substantial value addition can be achieved for the irradiated diamonds.

Table 2
Industrial EB processing applications by BARC-BRIT

S.NO.	Material (industry)	Application	Purpose
1	**PE 'O' Rings**	Cross linking	High temp. dimensional stability
2	**Cable insulations**	Cross linking	Better operating temperature and better heat resistance; improved aging characteristics; higher current rating etc
3	**Automotive plastic components**	Cross linking	Heat resistance; partial cross linking @selective locations of the components
4	**HV Busbar electrical insulation**	Cross linking	High temp. shape forming using vacuum mold technique; Heat Resistance; better aging; better arc resistance; anti-tracking;
5	**Diamonds**	Crystalline alterations	Colour enhancement
6	**PTFE scrap**	Degradation	Brittle; can obtain micro fine powder
7	**Viscose pulp**	Degradation	To reduce degree of polymerization from (DP); improved reactivity in rayon process
8	**Automobile tyre**	Pre-curing (improvement in green strength)	Dimensional stability during tyre buildup process; reduced curing time; less scrap; increased throughput better rolling resistance
9	**Nylon components**	Cross linking	Reduced water uptake and better shelf-life and improved mechanical properties. The material is suitable as railway liners

V CONCLUSION

DAE played a major role in the promotion of the EB technology in Indian industry. Several industrial applications have been developed and demonstrated at BARC-BRIT Complex using a 2 MeV/ 20kW industrial type pulse linear accelerator during the last decade, as tabulated in table 2. Also, an Electron Beam Centre (EBC) has been set up installing indigenously developed EB accelerators (10MeV and 3 MeV at Kharghar, Navi Mumbai) and another 10 MeV EB accelerator by CAT, Indore.

Thanks to the initiative from DAE, the technology has been successfully picked up by the Indian industry. During the last ten years, around seven EB machines have been installed by the wire & cable manufacturers in India and beneficially utilizing them to process several industrial products. Many more are on the way.

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PET Radiopharmaceuticals from Medical Cyclotron Produced Isotopes

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The medical cyclotron facility (MCF) installed at RMC, Parel, is used for producing positron emitting radioactive isotopes for clinical imaging using positron emission tomography (PET). The MCF was commissioned in October 2002, and dedicated to the nation by then Prime Minister of India.

PET provides the most specific and sensitive means for imaging molecular pathways and interactions in the tissues of man. PET images the physiological process at the molecular level, bridging the gap between laboratory science and clinical medicine. Due to its relevance in several diseases, particularly cancer, PET-imaging is making a major scientific as well as financial contribution to drug development, particularly for cancer diagnosis, staging and treatment, and for neurological diseases. PET-imaging requires radiopharmaceuticals (RPs) that are 'true metabolites' i.e., sugars, amino acids, fatty acids etc., essentially made of H, C, N and O which the cells in the body can metabolize. If we look for radioactive isotopes of H, C, N and O, for nuclear medicine imaging, we find only the short lived positron emitters C-11, N-13 and O-15, which are cyclotron produced. A suitable radioisotope of H is not available but, fortunately, F-18 (also cyclotron produced) can substitute for H in several metabolites.

The cyclotron is from GE Medical Systems, Sweden, called PETtrace, which is a compact upright negative-ion cyclotron that features a vertical mid-plane and accelerates protons to 16.5 MeV of energy and deuterons to 8.4 MeV of energy. It supports production of commonly used positron emitting radioisotopes mentioned above. Target beam currents of 75 μA for protons and 60μA for deuterons are achievable. It has the capability to perform simultaneous irradiation of two targets.

Fig. 1 Medical Cyclotron in indigenously designed bunker with ~2 metre thick concrete vault walls and ~1 metre haematite concrete roof. Local shield shielding built to reduce neutron streaming towards vault maze.

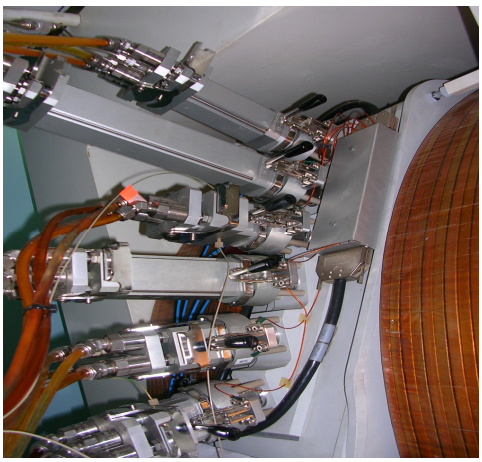
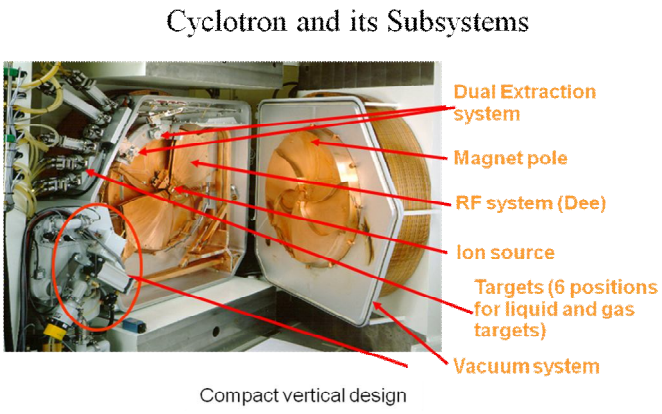


Fig 2. Targets for producing positron emitting isotopes. From below: targets 1, 2 & 4 are for liquid targets for producing F-18, N-13 and F-18 respectively. Targets 3, 5 & 6 are for O-15, C-11 and F-18 gas.



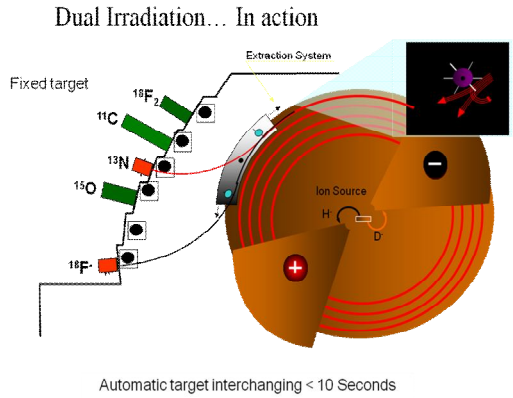


Fig 3. Cyclotron tank opened to show the cyclotron components and the H^- beam can be directed to dual targets as H^+ after stripping away the electrons.

Table 1.
PET-radioisotopes that are commonly produced in a medical cyclotron

Nuclide	T1/2	Mode of γ-ray production method (%)	Abundance energy(%) *(kev)*	Production methods and the common production method (**in bold font**)
^{11}C	20.4min	β+ (100)	511 200	^{10}B(d,n) ^{11}C, **^{14}N(p.α) ^{11}C**
^{13}N	10min	β+ (100)	511 200	^{12}C(d,n) ^{13}N, **^{16}O(p,α) ^{13}N**, ^{11}C(p,n) ^{13}N
^{15}O	2min	β+ (100)	511 200	**^{14}N(d.n) ^{15}O** ^{15}N(p,n) ^{15}O
^{18}F	110min	β+ (97)	511 194	**^{18}O(p,n) ^{18}F**

The H^- and D^- ion sources are contained in the same assembly. With the existing operation within 75 µA of target current, the ion source has an excellent life (typically over six months). The H- source operates on an internal H_2 gas whose pressure is maintained in the range 4-8 Torrs. To maintain this pressure a continuous flow of H_2 of about 5 ml per minute into the ion source is necessary. With a nominal beam current on the O-18 target is 40-50 µA, a production capacity of 3 Ci of $18F^-$ after 1 hour of proton bombardment is achievable. Larger quantities may be prepared by irradiating dual targets simultaneously.For e.g., targets 1 and 2 can be filled with O-18 water and bombarded simultaneously. The PETtrace ion source is of cold cathode Penning discharge type.

Three key sub-systems for yield improvement in PETtrace are: ion source, RF system and the target (Fig.2). Effective 18F- yield is determined by these cascaded factors, specifically, the level of ion-beam current generated by the ion source and the target design with optimal thermal and operating parameters. The RF system has to support the alternating acceleration voltage and should be capable of providing the power needed for acceleration of ions. The nominal beam

current on the standard 18F- target is 35-40μA with a specified production capacity of 2.5 Ci of 18F- after 1 hour of proton bombardment.

Fig 5. Shows on left, the FDG synthesis module, to which the F-18 produced in the cyclotron is sent. The F-18 is conerted to [F-18] FDG. On the right is the radioactive- waste gas compression system, which maintains the synthesis at a –ve pressure, and compresses the sucked air in cyclinders. After overnight decay the stored air is released to the atmosphere.

Radiological safety is ensured by the design and construction parameters that went into the system at the time of construction, reviewed periodically by the DSRC at that time. Fail-safe interlocks, search and clear operations, administrative controls, appropriate placement of area gamma radiation monitors, use of adequately shielded equipment, personnel protection have ensured that there were very few radiological hazards. The operations are monitored by the RSO on duty and a record is maintained of all the operations.

Equally important is the care required in producing [F-18] radiopharmaceutials since they will be injected into patients. The air quality in the environment is controlled to be Class 10,000 and there is a strict adherence to good manufacturing practices (GMP). Since the $T_{1/2}$ is 110 min, all the QC tests on the [F-18] FDG produced cannot be completed before dispatch. Hence, all the production procedures are validated before they are put to routine use. This ensures that any production batch will be safe for patient use with a very high level of confidence.

The MCF began by producing only [F-18] FDG in 2002 and was the first in the country to make available [F-18] NaF, [F-18] FLT and [F-18] FMISO to hospitals. Two other F-18 Radiopharmaceuticals, FET and FAZA are in the pipeline.

Till date, in the 12 years of MCF operations, nearly 5000 batches of [F-18] FDG and over 1000 batches of [F-18] sodium fluoride, has been produced and supplied to various hospitals.

Laboratory Research Irradiators with Enhanced Security Features

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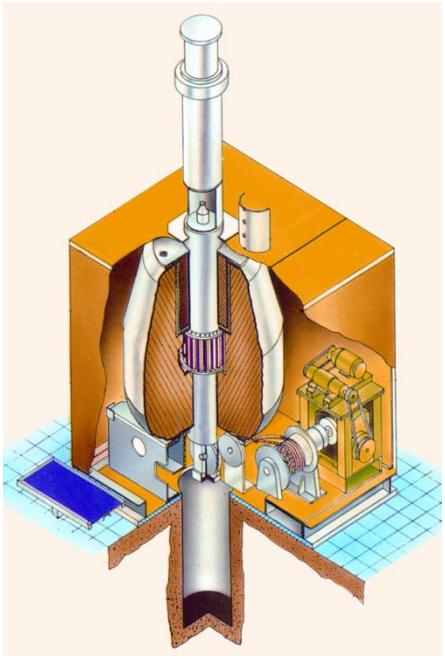
ABSTRACT
Over the years BRIT has developed state of art technology for laboratory research irradiators which are suited most for carrying out research and development works in the fields of radiation processing. These equipment which house radioactive sources up to 14 kCi are having a number of features to meet users requirements. They are manufactured as per the national and International standards of safety codes. The paper deals with design, development and application aspects of laboratory research irradiator called Gamma Chamber and also the new security features planned for incorporation in the equipment. Equipment are being regularly manufactured, supplied and installed by BRIT in India & Abroad. There is a number of such equipment in use at different institutions and are found to be very useful.

I INTRODUCTION

Applications of radioisotopes & radiation are finding increasing applications in many areas of Medicine, Industry, Agriculture and Research. To facilitate various types of studies and experimentation and to exploit their application commercially, it is necessary to have different types of radiation equipment which are meeting the user's requirements and are versatile, compact and safe to use. Board of Radiation & Isotope Technology (BRIT) is pursuing a vigorous programme of design, development and production of different types of radiation technology equipment for their use in various fields which are conforming to national and international standards and can be installed, operate and maintained in any institution. In order to study effect of radiation on material and to further ensure it commercial viability a Laboratory scale research irradiator called Gamma Chamber has been designed by BRIT which is manufactured supplied regularly. First Gamma chamber was developed in late sixties and since then many models have been designed with incorporation of new features. BRIT has supplied 185 units of different models including 31 which are supplied and installed abroad.

Gamma Chamber is self shielded research irradiator having radiation source Co-60 and sample chamber for controlled irradiation. It is self contained dry source storage category I type irradiator. Material for irradiation is to be placed in sample chamber located in central drawer of the unit. Equipment is provided with option to operate in auto or manual mode. Adequate shielding of lead and steel around the radiation source limits the radiation field on external surface well within the permissible limit. Good dose uniformity is attained by stationary source cage provided in equipment, in addition a mechanism for rotation and stirring is also provided which help enhancing dose uniformity.

A well planned quality control and assurance programme is adopted during all stages of design, manufacturing, testing and commissioning of these equipment to assure a supply of high quality product at competitive prices.



Gamma Chamber

Control panel

II DEVELOPMENT OF LABORATORY RESEARCH IRRADIATOR: GAMMA CHAMBER

It is a versatile equipment for research studied in many fields such as Radiation effect on material, Mutation breeding , Food preservation , Radiation chemistry, Radiation Sterilization, Sterile male insect technique etc.

Gamma Chamber is a small irradiator for irradiation of products under controlled conditions. It's development calls to meet a number of necessary parameters but with conflicting requirements not only from functional and manufacturing points of view but also from regulatory points of view so that the price of the unit remains economical, competitive and affordable for its sustained usefulness.

The following aspects, therefore, have been considered during design and development and subsequently manufacturing of these type of units.

(a) Design considerations: During the design, the following aspects are considered

(i) Functional
(ii) Regulatory and Safety
(iii) Manufacturing
(iv) Quality assurance and Control
(v) Transportation in public domain
(vi) Installation & handling

Design of Gamma Chamber usually starts with a given set of parameters having to do with the optimum amount of product volume to be treated and the dose desired. From these, the amount of source activity required to effect the treatment is determined and then a geometric configuration between the source and the product is decided to satisfy functional requirements. Considering all these factors. BRIT has designed and regularly manufacturing two models of this equipment Gamma chamber, 5000 & 1200 (GC 5000, GC 1200) which vary in irradiation chamber /sample chamber size and capacity of housing radioactive source. It is an equipment which can be installed in a room of size approx 4mX4m X4m (ht) and has capacity to irradiate sample size which can be accommodated in 5000 or 1200 cc chamber depending on model being used. It houses radioactive source Co- 60 in doubly encapsulated stainless steel pencils in a stationary cylindrical cage which emits radiation to the sample chamber in which object for irradiation is placed.

(b) Control System - A PLC based control system facilitates exposure of radiation on to products / samples for certain preset time for creating desired changes in the products. It mainly consists of following systems :

(i) A radioactive source, Co-60
(ii) Biological shielding
(iii) Mechanism of movement of Sample chamber into an out of irradiation field
(iv) The Irradiation/Sample chamber
(v) Control and safety devices

(c) Functional Requirements: Generally the following functional requirements are considered for the design of Gamma chambers.

(i) Size of irradiation volume – diameter & height.
(ii) Dose rate – Activity.
(iii) Dose uniformity – source configuration.
(iv) Shielding.
(v) Handling & installation.
(vi) Servicing & maintenance.

Since the equipment is used for sample irradiation for mainly research purpose optimum size of the chamber has been designed to ensure good dose uniformity.

III SAFETY ASPECTS

(a) Regulatory & Safety: Stringent requirements of safe transportation of radioactive materials as stipulated in the various national and international safety standards are to be met in the design of the components as well as in the systems of the irradiator apart from meeting the functional requirements. The design must meet Type B (U) requirements for safe transportation of equipment containing radioactive materials. Equipment has to meet tests of accidental conditions of the transport to get Type B (U) approval from regulatory body. Major tests of accidental conditions are indicated below.

(i) **Mechanical (Drop) Tests :** The equipment/package need to be dropped onto a hard unyielding target (atleast 10 times heavier than the product) through a height of 9m followed by a second drop through a height of 1 meter on a steel punch of 15 cm diameter rigidly mounted on the unyielding target.

(ii) **Thermal Test:** Following the above drops the same package is than required to be exposed to a thermal environment of 800 degree centigrade for 30 minutes, to assess the overall structural integrity of the package.

(iii) **Water Immersion Test:** In this test, the package is a water head of at least 15 meter for about 8 hours and the structural integrity of the specimen are further examined.

Transport of Gamma Chamber

Test Facility at ARAI, Pune

(b) Aacceptance Criteria: After going through the above tests the acceptance criteria in the shielding loss due to the cumulative effect of mechanical and thermal tests should not cause radiation level to increase beyond a permissible level as stipulated in the safety code. The Gamma Chamber meets all the performance criteria for qualifying as Type B (U) package.

(c) Manufacturing: Manufacturing of equipment is carried out by adopting various standard manufacturing codes. Materials of construction and manufacturing processes are carefully selected so that the products are not only fabricated of a very high standard but also are economically fabricated so that overall cost of the equipment is comparable to similar type of irradiators in international market.

(d) Quality Assurance & Control: A very stringent quality control and assurance programme is adopted during design, manufacturing and commissioning of these equipment to assure a consistent quality product supply. During the process, of development, the design is evaluated and validated by testing models and prototypes. During manufacturing a strict quality control programme is adopted to ensure use of right raw materials, processes, and other related tests. A complete documentation on design, manufacturing and their tests is generated for each type of equipment for traceability of any information at a later date.

IV ENHANCEMENT OF SECURITY FEATURES OF GAMMA CHAMBER

Gamma Chambers are being incorporated with enhanced security features necessary to ensure that radiation source used in the equipment are security protected during their use. Following modifications have been made in the equipment to deter, detect and delay the unauthorized access or theft or removal of radioactive material during all stages of its management.

(a) A limit switch will be mounted on one of the lugs of main unit. Any attempt to remove top cover of the cabinet will be sensed and a buzzer will give alarm.

(b) Additional 12 nos. of M 8 Countersunk Hexagonal headed screw in addition to the 12 no of M 20 hexagonal bolts will be fixed in the top plug of the main body of the cask to make top plug removal difficult.

(c) The M 8 screw heads will be covered/filled by magnet operated buttons. This will delay the process of opening of bolts.

(d) The cage plug will be covered by a top cover to conceal the hexagonal bolts and the socket head of countersunk screw to prevent direct access to bolts.

(e) An electrical plunger at the bottom of the cask will be attached and during the default position the plunger will stop the drawer to come down.

(f) A stopper plate will be attached to the bottom drawer to prevent it from lifting from the top.

(g) A stainless steel covers of 1.6 mm thick will be provided in the inner periphery of the source cage so that it will be difficult to attach the hook to the cage.

V CONCLUSION

With the vast experience in the design, manufacturing, installation and commissioning of the Laboratory research irradiator such as Gamma chamber over a period of time, it is possible for BRIT to design, develop and produce more safe, compact, user friendly laboratory research irradiator with the high density material for research applications which require irradiation of materials with ionising radiations of varying dose. Incorporation of additional security features will give confidence to the user as well as regulatory body for safety and security during all stages of its management.

Nuclear Facilities, Radiological Safetyand Radiation Exposure to Public: Concerns and Facts

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ABSTRACT
Man is living with radioactivity and exposure to ionising radiation and the usage of radioisotope or radiation for the benefit of mankind is on increase. There is understandably a high level of public interest in any 'Nuclear/Radiation' related news. On the other hand, timely availability of authentic / factual / credible information on the subject is limited. Due to this, there are several common misconceptions to the extent that any event immediately conjures up visions of deformed children, high cancer incidence, a Chernobyl type event or even a nuclear explosion like Hiroshima and Nagasaki. It is essential that any possible nuclear / radiation emergency especially in public domain is addressed in rational manner without any preconceived notion / bias. Due to the wide applications and usage of radioactive sources for the benefit of society, large number of radiological accidents (Goiania, Morocco, Mayapuri etc) has occurred, world over, compared to a few nuclear accidents. The number of deaths reported due to radiological emergencies is many times higher compared to the total number of deaths (58) due to nuclear emergencies (Chernobyl& Fukushima). Inthe accident at Chernobyl reactor release oflarge quantity of radioactivity to the environment took place due to the errors in design, operating procedures and lack of adequate containment to retain the pressure build-up.Inthe accident at Fukushima nuclear plants,release of radioactivity to the environment took place due to the unexpectedly severe Tsunami waves (more than 14m high) affecting the required continuous cooling for the removal of decay heat in the reactor fuel of the reactor cores though they survived the large magnitude earthquake. Inspite of the release of large quantity of radioactivity into the environment, which generated fear on the possible health effects among the exposed persons, there are no indications of occurrence of fatal cancer or other deleterious effects tothe member of public except few thyroid cancer casesdue to the exposure to radioiodinereleases.

I FACTS ON EXPOSURE TO IONISING RADIATION

By living in this world, we all are subjected to an average radiation exposure due to natural radioactivity/radiation of ~2.4mSv (0.0024Sv) per year. All persons emit radiation from the ^{40}K natural radionuclide present in their body which gives an effective dose of ~ 0.40mSv in a year to the person himself and also deliver radiation dose to the persons nearby depending on their proximity. Some parts of Kerala have got high radiation background areas (due to natural thorium) where people get exposed to radiation dose of more than 15mSv (0.015Sv) in a year. Eating a banana or drinking milk also can lead to intake of the ^{40}K radionuclide. But noradiation induced harmful health effects are reported among the people receiving the radiation exposure from the High Background Radiation Area (HBRA)).If the exposure exceeds 1Sv, receivable in a short duration; there is chance for the victim to show symptoms of nausea and vomiting. If the exposure exceeds 3-4.5Sv, there is 50% chance that person may die in 60 days (Fig-1) and if the exposure exceeds 10 Sv there is no chance of person's survival.

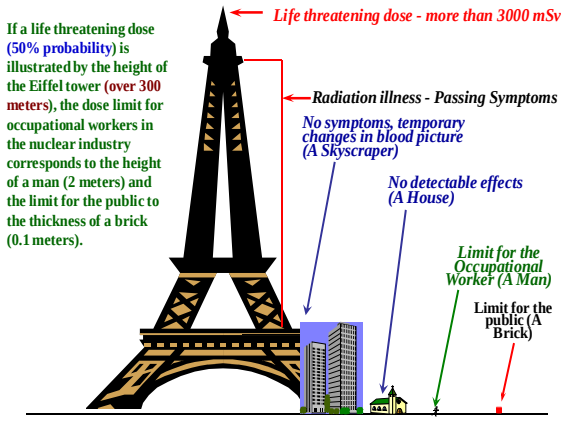

Fig1: Comparison of Radiation Exposure (Ref: IAEA)

Regarding the radiation exposure due to nuclear energy programmeand nuclear facilities, the members of public, in general, are not having adequate awareness due to which many havewrong notions about the effects of radiation, reactors and the radiological safety. Most of the persons are not aware that all of them are living with natural radiations right from the beginning of their birth receiving radiation doses every year (2.4mSv) which is at least 60 times the radiation dose they may get by staying very near to any operating nuclear power plant(Venkataraman, 2010) (Fig-2). Many believe that people living near nuclear power plants give birth to deformed children or getting cancer due to the radiation from the plants. As demonstrated by the detailed studies undertaken byvarious agencies neither at the reactor site nor at high background radiation areas(HBRA) ofKerala,no genetic effect or increase in the caner incidences attributable to the radiation exposure have been detected.

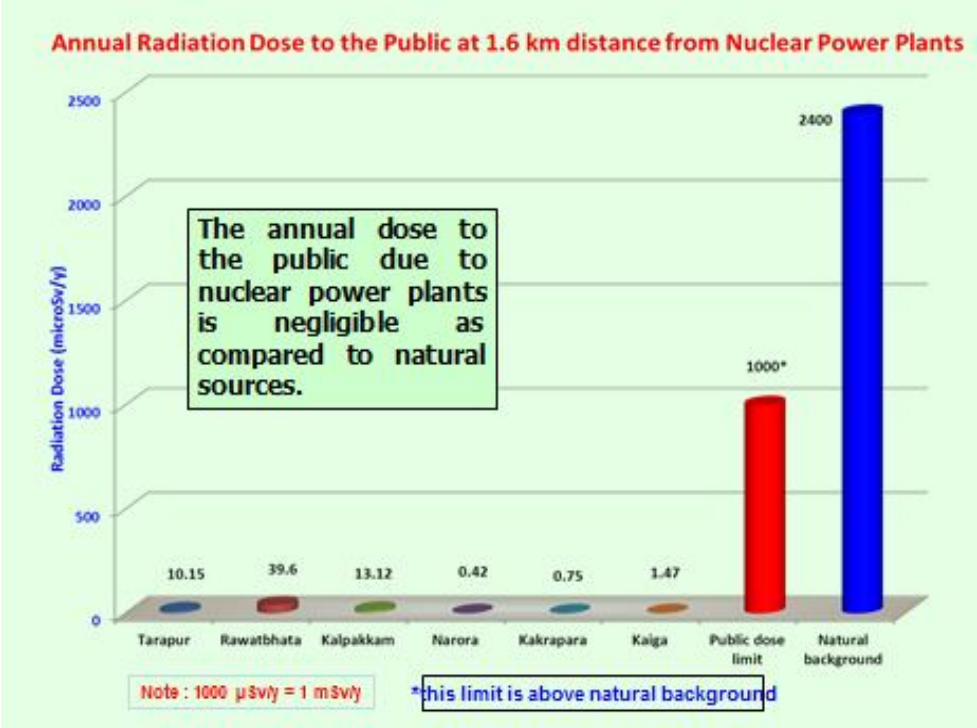

Fig-2: Comparison of radiation exposure at NPP's site boundary (1.6km) with Annual dose limit for the member of public

II ENSURING RADIOLOGICAL SAFETY AT NUCLEAR REACTORS

For nuclear facilities, safety is given the top most priority right from the site selection stage and then all through the design and operational stages of all nuclear facilities. The sites are selected preferably away from densely populated areas,at areas with adequate water resource to meet the cooling requirement of the facilities and negligible environmentalimpact due to radioactivity releases. The risks due to external parameters such as earthquakes, flooding, air accidents and any malevolent acts are taken into account when the facility is designed. In India, the Nuclear Power Plants (NPPs) are designed and operated ensuring safety to the operating staff, member of the public and environment. All NPPs in India have a three tier system to

(a) reduce the probability of accidents by incorporating many engineering safety features

(b) reduce the quantity of radioactivity release to the environment by having adequate containment (to contain the pressure built-up following a major accident/ retain the radioactivity even if core meltdown occur)

(c) have emergency preparedness in place for nuclear facilities which will enable quick assessment of radiological status following any accident to enable implementation of countermeasures for reducing the radiological consequences and protection of member of the public and environment.

Nuclear reactors, while in operation, continuously generate energy from the controlled fission reaction, fission products that are highly radioactive and the radioisotopes produced by neutron activation (including those used in medical and industrial applications). Each reactor will have large inventory of radioactivity i.e., millions of Curie activity (1 Ci = 3.7 x 10^{10}Bq) contained within the reactor. Even during an accidental scenario, large number of barriers needs to be penetrated for the activity to come out of the reactor and to reach the public domain. Detailed safety measures at various stages, i.e., site selection, design, construction and operation, are incorporated in all nuclear facilities to ensure that the radiation exposure to occupational workers as well as to the member of public is much below the prescribed limits.

The architecture used in reactor consists of a metal enclosure (cladding) to the nuclear fuel, a steel vessel which protects the reactor core (extended by the metal envelope formed by the pipes of the primary heat transport system) and the containment building which surrounds the whole reactor. During the operation of the nuclear facilities, it is always ensured that the releases to the aquatic as well as atmospheric environment will not lead to any significant exposure to the member of public. The radiation exposure to any member of public due to the operations of NPPs falls into a small fraction of the annual limit of exposure to the members of the public(1mSv) which by itself is less than 50% of the natural radiation exposure(2.4mSv) we receive every year by living in this world.

Strict administrative control is also exercised to ensure safety of the reactor as well as the protection of member of the public against any possibility of large scale radioactivity releases. It is always ensured that 'The annual risk to the most exposed member of the public due to accidents in a reactor to be extremely small in comparison to his/her total risk of premature death'.

III RADIOLOGICAL IMPACT PARAMETERS

The radiological impact of any nuclear/radiological emergency depends on the following parameters (Pradeep kumar, 1998):

(a) Source term of the accident (quantity of radioactivity release)
(b) Height of the release for the gaseous effluents
(c) Topography (of the area to which it is released)
(d) Characteristics of activity release,
  (i) Isotopic composition,
  (ii) Physicochemical form,
  (iii) Delay and duration of release
(e) Meteorological conditions during the release –
  (i) wind direction
  (ii) wind speed
  (iii) stability class
(f) Population distribution with respect to direction and distance from release point
(g) Level of radioactive deposition / contamination on ground
(h) Implementation of countermeasures (if carried out in time)

All the above factors are taken into account to assess the maximum possible exposure and for strengthening the emergency preparedness for nuclear facilities.

The risk to member of public from any major accidents in a NPP, though probability is extremely small, will be mainly attributed to exposure to ionising radiation. Experiences from Chernobyl and Fukushima accidents have demonstrated that the psychological trauma may be much more than any other health effects the releases can cause to the member of public. Radiological consequences can be avoided or significantly reduced if countermeasures can be implemented effectively which require preparedness for emergency response in place for all nuclear facilities.

The fundamental logic for all emergency preparedness is that: money to be spent for response with 'preparedness for emergency response' will be very small compared to the money required for responding to an emergency without 'preparedness for the response'. The zoning concept followed in NPP helps in enforcing the emergency preparedness as well as periodic exercises for such facilities. Systems and methodologies for quick assessment of radiological impact, developed in BARC (Pradeepkumar,1998, Pradeepkumar,2003) and kept in readiness have very important role in helping the decision makers on the appropriate countermeasures at the desired locations.

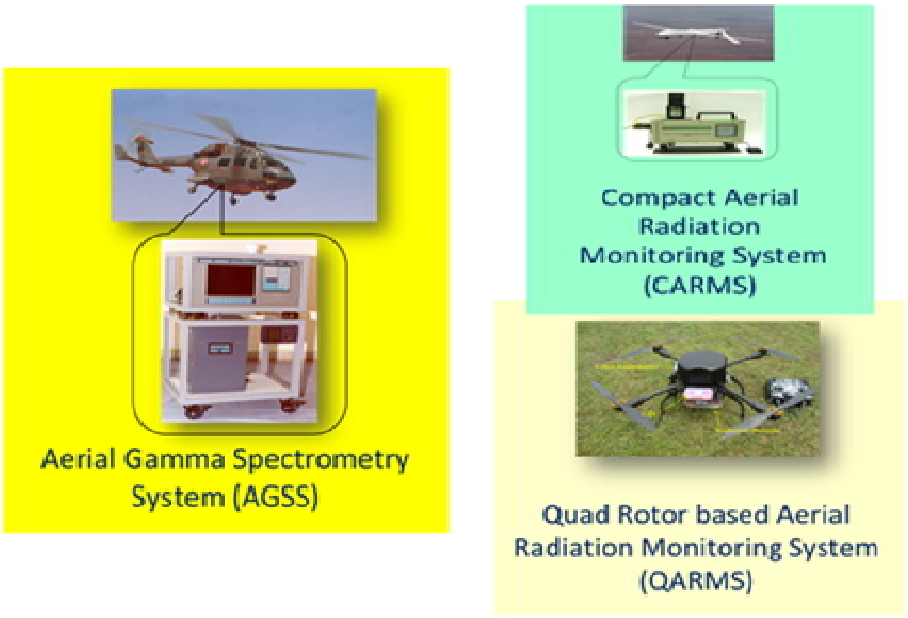

Fig-3: State of the art radiation monitoring Systems Developed in BARC for meeting the challenges of 'Orphan sources' and Radiological Emergencies

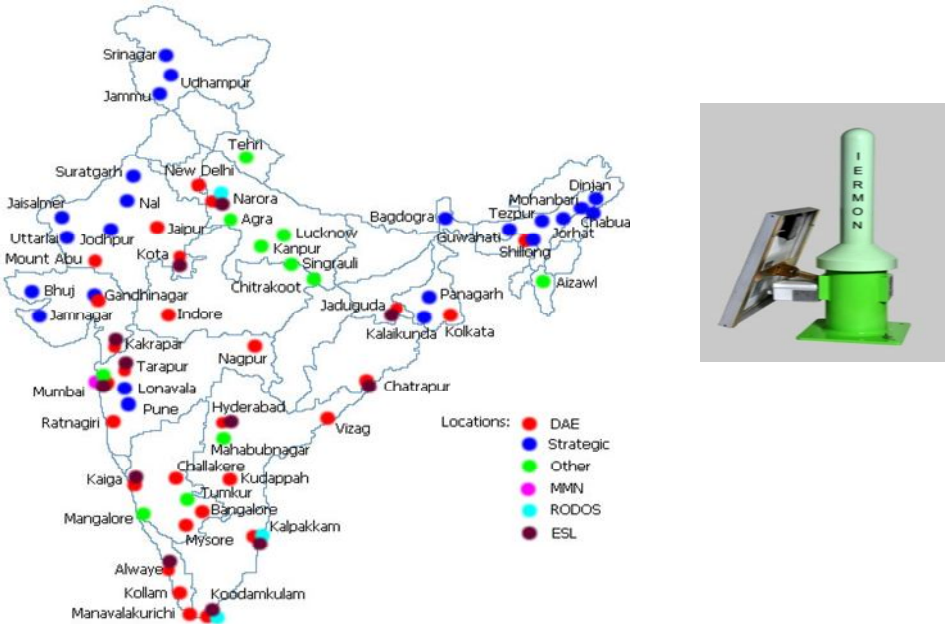

Fig-4: Countrywide network of 421 Indian Environmental Radiation Monitoring Network (IERMON) with online Data Communication to DAE's Emergency Response Centre

Proposed BARC supported National Level Emergency Preparedness- With BARC as leading agency for technical aspects on (NPP related off site-emergencies)

1. **Exhaust Monitoring System**
2. **Indian Real Time Online Decision Support System (IRODOS)**
3. **GIS Supported Impact Assessment**
4. **Aerial Gamma Spectrometry System (AGSS), Software & Methodology for Assessment of Large Area Contamination**
5. **Compact Aerial Radiation Monitoring System (CARMS) for remote aerial surveys using UAVs**
6. **Mobile Radiological Impact Assessment Lab(M-RIAL)**
7. **Twenty-two DAE Emergency Response Centers (ERCs)**
8. **Indian Environmental Radiation Monitoring Network (IERMON)**

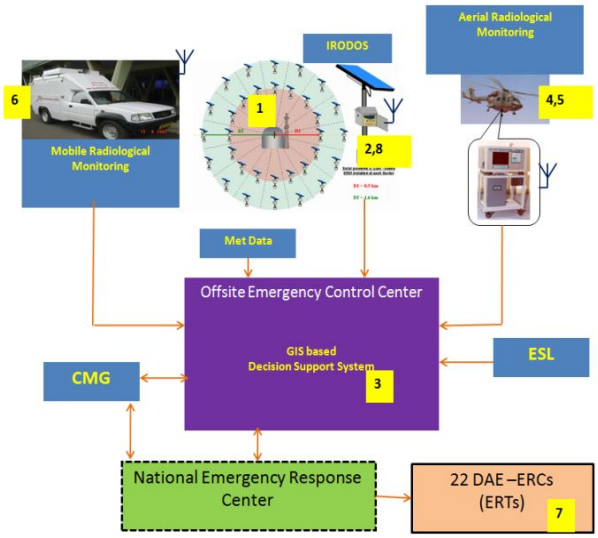

Fig-5: Systems and Monitoring Methodology for prevention and response to Nuclear Emergencies

IV RADIOLOGICAL IMPACT FROM FUKUSHIMA ACCIDENT AND THE PUBLIC CONCERN

A massive earthquake and the subsequent Tsunami created disaster in Japan in March 2011, killing thousands of persons, making large number of people homeless as well as huge economic loss to Japan. The impact of the Tsunami with level of water crossing 14 m height was felt very seriously at NPPsat Fukushima compared to other reactor sites. It led to failure of electric power (extended station blackout), failure in the removal of decay heat and subsequent release of radioactivity to environment from 4NPPs at Fukushina, Dai-ichi. Though the nuclear emergency has not led to lethal radiation exposure to anyone including the emergency workers, Japan had to implement emergency countermeasures including evacuation, sheltering and control over the consumption of food products etc.

The assessed radiation exposure to member of public from releases at NPPs at Fukushima is not significant enough to generate any radiation injury. Immediately after the nuclear accident, Japan government got prepared for Iodine prophylaxis (to protect persons from intake of radio Iodine) and evacuated people as a matter of precaution to respect the psychological issues which are sure to follow later. Based on the lessons learnt from the large number of radiological accidents (including 'Mayapuri radiological emergency at Delhi' where exaggeration lead to spread of 'fear of the unknown' and radiation phobia even in qualified persons**)** and nuclear accidents like Chernobyl and Fukushima, it is to be understood that even for very small level radiation exposure, many may believe that they are all affected. There are cases where even friends/ doctors believed that they should not touch / shake hands with the persons exposed to radiation. As demonstrated after Chernobyl accident, large number of pregnant woman in Europe, were worried of deformed births and wentfor abortion, even when they were assured by the authority that they had not received significant radiation exposure from Chernobyl fallout cause. Even after 25 years of the accident, no increase is detected so far in leukaemia, congenital abnormalities, adverse pregnancy outcome or any other radiation induced disease at Chernobyl or anywhere in the world (though increase in carcinoma of the thyroid was reported for very high intake of radio-Iodine by children UNSCEAR, 2015).

V COMPARISON OF NUCLEAR EXPLOSION AND NUCLEAR REACTOR ACCIDENT

On many occasions, it is found that nuclear emergency due to nuclear reactor accidents are compared to nuclear disaster due to nuclear explosion. It is highly unlikely for a nuclear reactor to explode like an atomic bomb and in a nuclear

explosion the immediate damage and casualties are caused by blast (35%) and thermal effects (50%), which is absent in a reactor accident. Even if the highly unlikely event of reactor explosion occurs, most of the blast and thermal energies will be absorbed by the reactor containment itself. The radiation field due to reactor accident will depend upon the type of fuel and the burn-up of the fuel.In case of nuclear explosion, as the mushroom (radioactive cloud) rises to a height of 8-10 km depending upon yield, the impact of fallout is at very large distances which is not so in case of a reactor accident.

Another myth people believe that are actor can explode like a nuclear bomb (Hiroshima) and create the same level of damage. While a nuclear explosion above the surface release all the radioactivity generated by the fission, even in Chernobyl, a large amount of radioactivity was retained as a matrix and did not get released to environment.

In India, we have emergency preparedness for nuclear and radiological emergencies which include nuclear accidents and radiological accidents that could affect public domain. Various radiation emergency scenarios are identified and preparedness for response is strengthened based on the potential threat including malicious acts involving use of radioactive materials. In addition to Department of Atomic Energy (DAE's) expert emergency response teams at the 23 DAE-Emergency Response Centres established in the country over the last few years, National Disaster Response Force (NDRF) teams of NDMA are also being trained in radiological emergency response.

VI LESSONS FROM RADIATION EMERGENCIES

News related to radiation generates curiosity and concern whether it is related to environmental release of radioactivity or due to suspected presence of a radioactive material in public domain. As demonstrated after the nuclear accidents at Three Mile Island (TMI), Chernobyl and Fukushima as well as during and after radiological emergencies at Goinaia, Tammiku, Liloreported from world over and from Mayapuri, India, the number of people believing they are affected or will be affected by radiation or contamination is found as extremely large in comparison to those actually affected. During such occasions, the response personnel find it difficult to match with the requirement of monitoring and implementation of countermeasures in anticipation of worsening emergency scenario.

Hiroshima and Nagasaki nuclear explosion created the fear factor among the public of the radiation, its effects, possible radioactive fallout and contamination of wide area. The data from Japan, from the large number of persons affected by the radiation exposure, helped in the generation of the risk factors by ICRP, the conservatively used Linear No Threshold (LNT) concept for large collective dose scenario creates lot of misconception and fear among the society to that extent that the loss due to Tsunami in Japan is forgotten compared to relatively insignificant radiological consequences from Fukushima. Even though there was widespread radioactive contamination in Japan, the radiation exposure to public due to Fukushima accident is not expected to produce any harmful health effect. Except thyroid cancer, actual number of Cancers so far detected among public and attributable to radiation exposure are almost nil even 28 years after Chernobyl accident.

Radioactivity releases into the atmosphere from NPPs at Fukushima was detected over Japan, US and even in Europe due to the highly sensitive radiation detectors, gave a false impression that the radiological impact from these releases is wide spread and is very significant. Though the inventory of radioactivity for the 4 Units of NPPs at Fukushima-Dalichi which got into serious accident were much higher than the Chernobyl reactor whose core was melted and did not have a proper containment, deposited activity on land is significantly smaller in comparison to Chernobyl.

Since radiation cannot be seen or smelt following any radiation incidents/accidents, rumours can create panic till radiological monitoring is carried out to assess the actual status to remove the 'fear factor'. Those who are not affected but believing 'as affected' will be many folds (examples: Mayapuri, Goiania, Fukushima, Chernobyl). The case study of nuclear emergency at Fukushima has demonstrated that though the reactors have undergone significant damage, the radiologicalexposure in public domainis not very high. The release from the facilities have not lead to any dangerous level of environmental contamination, though fission products like Cesium-137 and Iodine-131had reached thousands of km from the NPPs.

VII CHALLENGES FROM ORPHAN SOURCES

World over millions of radiation sources are in use/ available, wherein majority of sources are relatively harmless. Considering the large number of sources reported as missing and many 'orphan sources' (Gonzalez, 1999) detected in public domain, prevention of illegal trafficking of

radioactive sources are to be given top priority to prevent radiological emergencies.

Wide use of radioactive materials in industry, agriculture, power- generation, medicine, research and possibility of terrorism has increased the potentiality of radiological emergencies. During the last 50 years, 400 accidents are reported from which led to more than 3000 persons injured and 120 fatalities including the 28 victims from the Chernobyl accident. Though the WTC attack led to the strong belief over the terrorists intentions, concern over the malicious use of radioactive sources by terrorist groups to deliberately make societal havoc was expressed in many international platform even before. The likelihood of the use of radioactive sources as Radiological Dispersal Device (RDDs)(ICRP, 2005, FEMA, 2010) is much higher compared to the use of an improvised Nuclear Device(Brooke, 2010) or the attack on a Nuclear Power Plant. Usage of an RDD may trigger panic out of proportion of actual risk to human health and safety. The possibility that terrorists may try to use radioactive materials requires that public officials, emergency services, and medical facilities be prepared to identify and cope with a potentially wide range of problems.

Table-1
Major Radiological Accidents and Health Consequences
(Compiled from IAEA reports)

Country	Source	Source Strength (TBq)	Health consequences
Istanbul	Co-60	23.5	Severe injury–life threatening
SamutPrakarn	Co-60	15	3 deaths
Tammiku	Cs-137	7.4	1 death
Goiania	Cs-137	50	4 deaths
Lilo	Cs-137	0.164	Severe injury
Lilo	Cs-137	0.126	Severe injury
Yanango	Ir-192	1.37	Severe injury–life threatening
Gilan	Ir-192	0.185	Severe injury
Morocco	Ir-192	1.2	8 deaths
Georgia(RTGs)	Sr-90	~1000	Severe injury–life threatening
Mayapuri(Delhi)	Co-60	0.74	1 Death

Approximately 86,000 atomic bomb survivors in Japan had a 5.4% increase in cancer mortality in 40 years; but 10,000 irradiated residents in Taiwan had a 97% decrease in cancer mortality. Radiation Exposure In Taiwan (The true health effects of radiation,Luan YC, et al.) was caused due to ^{60}Co-source inadvertently mixed in metal scrap, melted and drawn into steel bars which were used in the construction of 1700 apartments for about 10,000 residents in 1982-84.Residents were irradiated at least for 9 years, some up to 20 years. Annual dose in the first year 1983 was from about 50 - 600 mSv/y. Total averaged dose started at 0.4 Sv - 6 Sv. Based on the analysis of exposure cases and the effects observed the conclusions arrived by the scientific community are

(a) chronic radiation exposure may actually be beneficial to humans,

(b) lower incidence of cancers compared to that expected,

(c) lower incidence of congenital anomalies compared to that expected.

Based on the concern of the public and possible nuclear and radiological emergency scenario, national level emergency preparedness (Pradeep kumar, 2008, IAEA, 2007, IAEA,2011) is upgraded:

(a) For immediate assessment of any suspected large area radioactive contamination

(b) For the search of lost sources or suspected stolen sources,

(c) Monitoring of large number of persons, who believe they are contaminated

(d) Monitoring of large number of environmental samples suspected of radioactive contamination

(e) Requirement to large number of Emergency Response teams, monitoring and protective equipment, First Responders etc

(f) State of the art radiation detection and assessment systems and methodology

(g) Network of Radiation Emergency Response Centres with DAE and Government organizations

(h) Public awareness for Common man and media

(i) Medical management of victims of Nuclear and Radiological emergencies.

The existing DAE-ERCs and the DAE's Emergency Response Teams have carried out many radiological response activities independently and collectively during suspected radioactive material in public domain, search of sources(Chatterjee, 2008), aerial survey exercises and prevention and response to radiological emergencies during Commonwealth Games.

VIII CONCLUSIONS

Nuclear accidents like Chernobyl and Fukushima,though had led to release of large quantityof radioactivity to the environment, the harmful health effects in member of public is found to be extremely small, except it generated unimaginable trauma among the public. During any radiation related emergencies, in the absence of adequate awareness,number of people who may believe they are affected by the exposure to ionizing radiation and may live with a fear of getting cancer can be extremely largein comparison to the possible victims.This is mainly due to the belief that any level of exposure to radiation is harmful, and that the effects of high doses of radiation can be extrapolated to low doses of radiation based on LNT model, though below 100mSv of radiation dose there is no scientific observation support it.

It is observed internationally that challenges from orphan sources are on increase. Hence storage, transportationand usage of radioactive sources requires strict administrative control to ensure safety and security of the sources to prevent inadvertent exposure due to radiological emergencies or by malicious acts leading to radiation injuries.

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Radiation Technology in Agriculture for Development of Improved Crop Varieties

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ABSTRACT
Radiations and radioisotopes are used in agricultural research to induce genetic variability in crop plants to develop improved varieties, to manage insect pests, monitor fate and persistence of pesticides, to study fertilizer use efficiency and plant micronutrient uptake and also to preserve agricultural produce. Use of radiation and radioisotopes in agriculture is one of the most important fields of peaceful applications of atomic energy for societal benefit and BARC has contributed significantly in this area especially in the development of new mutant crop varieties. With an effective blend of induced mutagenesis along with recombination breeding 42 new crop varieties developed at BARC have been released and Gazette notified by the Ministry of Agriculture, Government of India for commercial cultivation. These include 21 in oilseeds (15-groundnut, 3-mustard, 2 soybeans, 1 sunflower), 19 in pulses (8-mungbean, 5-urdbean, 5-pigeonpea, 1-cowpea) and one each in rice and jute. Some of the desirable traits which have been bred through induced mutations in these crops include higher yield, improved quality traits, early maturity and resistance to biotic and abiotic stress. Several of these varieties have high patronage from the farming community and are extensively grown across the country.

I INTRODUCTION

Indian agriculture in the past has witnessed green revolution, which has changed the nation's status from a food importing to a self sufficient nation. In spite of industrialization, India remains an agrarian economy, and over 50% of its population is employed in agriculture and related enterprises. The national agricultural policy focuses on sustained production and nutritional security for the one billion plus population. Food grain production in India stands at around 255 million tons and by 2025 we may need about 340 million tons to feed the increasing population To further increase agricultural productivity equitably in an environmentally sustainable manner in the face of diminishing land and water resources is a highly challenging task. There is a need to develop better crop varieties which are high yielding and resistant to biotic and abiotic stresses.

The Department of Atomic Energy through its research, development and deployment activities in nuclear science and technology, has been contributing towards enhancing the production of agricultural commodities and their preservation. Radiations and radioisotopes are used in agricultural research to induce genetic variability in crop plants to develop improved varieties, to manage insect pests, monitor fate and persistence of pesticides, to study fertilizer use efficiency and plant micronutrient uptake and also to preserve agricultural produce. Use of radiation and radioisotopes in agriculture which is often referred to as nuclear agriculture is one of the important fields of peaceful applications of atomic energy for societal benefit and BARC has contributed significantly in this area.

II RADIATION TECHNOLOGY IN THE DEVELOPMENT OF NEW CROP VARIETY

Traditionally, selection and hybridization have been employed in the improvement of crop varieties for enhancing agricultural productivity. Genetic variability in crop plants is a valuable resource from which the plant breeder can select and combine different desired characteristics to produce better crop varieties. Natural variability is generated by spontaneous mutations which occur at extremely low frequency (roughly 10-6). This can be enhanced to several fold (approximately 10-3) using chemical or physical mutagens. Mutations, spontaneous or induced, are an important source for inducing genetic variability. Improvement in either single or few economic traits and quality characters can be achieved with the help of induced mutations within the shortest possible time. Induced mutations have widely been accepted as a supplementary approach in the crop improvement programme, thus speeding up the breeding programme considerably.

Mutations can be induced using a variety of radiations including gamma- rays (^{60}Co, ^{137}Cs), X-rays, beta particles, neutrons etc. Among these, gamma-rays have been extensively used, due to convenience of handling and better penetrating power. Gamma radiations bring about mutagenesis by interacting with the DNA mainly causing single or double strand breaks. These DNA lesions can lead to simple mutations and chromosomal aberrations. Useful mutations are selected from a large number of random mutations. Among the induced mutants released world wide as varieties for cultivation, about 60% were produced using gamma rays. Some of the other physical mutagens

include particle accelerators, electron beams and mutations induced by cosmic rays in space.

Crop improvement programmes at BARC employ radiation based induced mutagenesis along with recombination breeding in oilseeds (groundnut, mustard, soybean and sunflower), pulses (urdbean, mungbean, pigeon pea and cowpea), cereals (rice and wheat), and vegetatively propagated plants like banana and sugarcane. The desirable traits which have been bred through induced mutations include higher yield, improved quality traits, early maturity, disease and pest resistance, improved plant type, increased harvest index, semi-dwarf habit and abiotic stress resistance. Crop improvement programme makes use of the induced variability either by using the desirable mutants directly or by using them in cross-breeding to combine the desirable traits. Induction of modified traits and their incorporation in an ideal genotype could be achieved by a well planned and judicious use of induced mutation and hybridization techniques. Mutants or recombinants initially developed at BARC are evaluated in collaboration with the Indian Council of Agricultural Research (ICAR) or State Agricultural Universities in multi-location trials for various agro-climatic zones and the promising ones are released for commercial cultivation by the Ministry of Agriculture, Government of India (MoA, GOI). After notification, varieties enter into the seed chain of nucleus seeds, breeder seeds, foundation seeds and certified seeds. Certified seeds are supplied to the farmers for cultivation. With an effective blend of mutation and recombination breeding, 42 new crop varieties developed at BARC have been released and Gazette notified by the MoA, GOI for commercial cultivation. These include 21 in oilseeds (15-groundnut, 3-mustard, 2 soybean, 1 sunflower), 19 in pulses (8-mungbean, 5-urdbean, 5-pigeonpea, 1-cowpea) and one each in rice and jute (Table 1). The Trombay varieties can easily be identified by their names, which include the first letter T for Trombay where BARC is situated, the other letters indicate collaborating institutes e.g. TAU-1 is Trombay Akola Urid-1 where Dr. Punjabrao Deshmukh Krishi Vidyapeeth (PDKV), Akola is a collaborator (Table 1) .

III SOCIO-ECONOMIC IMPACT OF TROMBAY MUTANT VARIETIES

Some of the Trombay crop varieties have been very popular among the farming community. These are grown extensively in the country and have made a good impact on our National agriculture scenario by benefiting the farmers considerably. The Trombay pulse varieties are popular in Southern and Central India based on their high yielding ability and disease resistant characters. The blackgram variety TAU-1 is the most popular variety in Maharashtra. Based on the feedback received from Maharashtra State Seed Corporation, Akola and National Seed Corporation, Pune, they supplied over 21,013 metric tonnes certified seed of TAU 1 to farmers. Recently (2013) another blackgram variety TU-40 has been release for Andhra Pradesh, Karnataka, Tamil Nadu and Orissa. This variety is resistant to yellow mosaic virus and leaf spot disease and is suitable for rice fallows

In mungbean, major bottlenecks were the susceptibility of existing varieties for yellow mosaic virus and powdery mildew diseases. Successful incorporation for powdery mildew resistance in high yielding mutants resulted in powdery mildew disease resistant varieties TARM-1, TARM-2 and TARM-18 for the first time in India. The variety TARM-1 suitable for *rabi* and rice fallow cultivation became very popular in Orissa State. TMB-37 has been released for summer season, having early maturity (55-59 days) and yellow mosaic virus disease resistance that made available an additional area for mungbean cultivation under crop diversity programme. TMB-37 has become very popular in Madhya Pradesh**,** and is also being introduced in Bihar, West Bengal and Assam States. Subsequently, pyramiding for multiple disease resistance led to the variety TJM-3, which is the first variety released with multiple disease resistance to powdery mildew, yellow mosaic virus and *Rhizoctonia* root-rot diseases. This variety which was field tested in collaboration with Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur, is very popular in MP. TM-96-2 is the first variety released for rice fallow cultivation in India, which is having powdery mildew resistance and synchronous maturity which are the essential traits for rice fallow cultivation, where nearly four million hectares of rice fallow area is available in India and considered prime area under crop diversity programme. This variety was field tested in AP in collaboration with N.G. Ranga Agriculture University is becoming popular in AP for rice fallow cultivation. Trombay pigeon pea TT401 and TJT-501 varieties are gaining popularity in the Central Zone comprising of Maharashtra, Madhya Pradesh, Chhattisgarh and Gujarat States. The recent addition (2014) is the high yielding pigeon pea TARA released for Maharashtra

Trombay groundnut varieties are very popular among the farming community and are cultivated throughout the nation in view of their higher yields, early maturity and better water use efficiency. Some of them have an additional useful trait of fresh seed dormancy of 20-30 days thus preventing *in situ* seed germination due to end season rains when the crop is ready for harvest. This trait is very

useful under current changing climatic conditions wherein unpredictable rains are often experienced. Among the released TG varieties, TAG-24, TG-26, TG 37A, TG 38, TG 51 in normal seed class and TKG 19A, Somnath, TPG 41, TLG 45 in large seed class are popular among the farmers of major groundnut growing states such as Gujarat, Andhra Pradesh, Maharashtra, Karnataka, Orissa and Rajashtan and are also becoming popular in West Bengal, Punjab and Tamil Nadu, Madhya Pradesh, Uttar Pradesh and Goa. TAG-24 is the most popular TG variety grown throughout the country Farmers have been realizing the high yielding ability of groundnut varieties by harvesting record groundnut yields in many parts of the country. Hundreds of farmers were harvesting significant improved productivity even upto 7 tonnes/ha when recently released groundnut varieties were introduced in these states. One of the notable contribution of BARC has been in the development of early maturing confectionery grade large seed groundnut varieties (100-seed weight >60g) suitable for export and Table purpose. Existing large seed varieties were with long duration, longer seed dormancy and low productivity. However the recently released large seed mutant varieties like TBG (TDG) 39, TPG 41 and TLG 45 benefited many farmers by virtue of their earliness, moderate seed dormancy and superior productivity. Trombay varieties also facilitated farmers to develop newer cropping systems like intercropping groundnut with sweet corn, sugarcane; onion and use of polythene mulch technology for intensive groundnut cultivation.

Mutation breeding programme is also complemented with biotechnological approaches. Molecular markers are useful in crop improvement programmes for varietal identification, marker assisted selection, estimating genetic distances, linkage studies, phylogenetic analysis and tagging and cloning of desirable genes. Genomic assisted breeding and gene pyramiding for disease resistance and other economically important traits will help in hastening the mutation breeding programme. Mutated genes have also become a valuable resource to plant breeders and molecular biologists for understanding not only the function but also in isolating and shuffling the genes between varieties. At BARC, molecular markers have been used to tag agronomically important traits such YMV and bruchid resistance in urdbean; rust and late leaf spot resistance in groundnut; rust resistance in wheat and flowering time in *Sesbania rostrata*.

Some programmes at BARC in plant biotechnology are in the micro propagation of banana, pineapple, sugarcane, grapes and other economically useful plants. The tissue culture technique has been transferred to the user agencies such as Maharashtra State Seeds Corporation (Akola), Perunthalaivar Kamaraj Krishi Vigyan Kendra (Government of Pondicherry), Anandwan (Warora), Community Action for Rural Development Society (CARD, an NGO at Anjangaon-Surji) for commercial production and distribution to farmers. Cell culture/hairy root based production of bioactive compounds using bioreactor has also been developed. Studies have also been initiated for developing transgenic plants for disease resistance, for the production of edible vaccines and phytoremediation.

IV USE OF RADIOISOTOPES IN SOIL SCIENCES AND PLANT NUTRITION AND FATE AND PERSISTENCE OF PESTICIDES AND OTHER AGRO-CHEMICALS

Radioisotopes are used as a ‘tracer’ or ‘label’, which enable scientists to follow the movement of individual atoms and molecules in soil-plant system. The radioactive atoms reveal their presence by their radioactivity, which can be detected by suitable counters. The experiments using fertilizers labeled with radioactive isotopes facilitate the estimation of the optimum fertilizer requirement of plants, their biological transformations, translocation, the site of utilization in the plant, time of application, and also in quantifying their losses from soil. Radioisotopes are useful in generating information on mineral plant nutrition such as uptake of micronutrients etc using isotopes such as ^{59}Fe, ^{54}Mn, ^{65}Zn, ^{90}Mo etc. Patents for a new phosphorus (Patent no. 238485, 2010) and a zinc (Patent No. 239929, 2010) biofertilizer formulations have been obtained based on their evaluation using ^{32}P and ^{65}Zn as tracers [6,7]. The fate of the pesticides and other agro chemicals used in agriculture, their degradation products and their persistence in the ecosystem can also be studied using radioisotopes. For plant uptake and physiological studies, stable isotopes such as ^{15}N and ^{18}O are used as tracer. ^{14}C-labelled pesticides have played an important role in discerning the behavior of these agrochemicals in the environment. Model ecosystems have been developed and used in the laboratory to study the degradation of commonly used pesticides in Indian agriculture. Some of the fertilizers and agrochemicals labeled with a radioisotope such as ^{14}C, ^{35}S, ^{3}H and ^{32}P are tailor made by the Board of Radiation and Isotope Technology (BRIT), Department of Atomic Energy for use.

V INSECT PEST MANAGEMENT

Sterile insect technique (SIT) is gaining importance as an ecofriendly approach for the control of insect pests [2]. SIT includes mass rearing of target insect, inducing sexual sterility with radiation in adults (especially males) without affecting their mating vigour and competitiveness and release of such sterile adults in overwhelming number in natural population. This process limits the reproductive ability of natural population and brings down the insect population to a manageable level or even can eradicate completely. At BARC, attempts have been made to study SIT for controlling red palm weevil, potato tuber moth and spotted bollworm of cotton. Pheromones and bio-pesticides have also been developed for use in integrated pest management.

VI LAB TO LAND DEPLOYMENT FOR SOCIETAL BENEFIT

For the dissemination of research efforts of BARC to the farmers, effective linkages have been established with ICAR, State Agricultural Departments, State Agriculture Universities, National and State Seed Corporations, NGOs, National Institutes, Krishi Vigyan Kendras, progressive farmers etc. Large scale production of nucleus/breeder seeds is undertaken at BARC farms at Trombay and Gauribidanur, Karnataka and also in collaboration with progressive farmers and Agricultural Universities. Breeder seeds are supplied to different National and State Seed Corporations for multiplication into foundation and certified seeds to reach the farmers. Popularisation is also done through kisan melas, awareness programmes, science exhibitions and frontline demonstrations in farmers fields.

VII CONCLUSION

Our experience has shown that using radiations for crop improvement has come to stay as an efficient plant breeding method complementing the conventional methods. Clearly, the nuclear technologies have benefited the farmers, traders and end-users and will continue to play a significant role in addressing food and nutritional security.

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Table 1:
Trombay crop varieties released and notified for commercial cultivation by Ministry of Agriculture, Government of India

Variety	Year of release	States	Special features
Groundnut			
TG 47 (RARS T1)	2011	ANDHRA PRADESH	Large seed, 115 days maturity
TDG 39/ TBG 39	2009/ 2008	KARNATAKA/ RAJASTHAN	Large seed, medium maturity, high oleic acid, more number of branches.
TG 51	2008	ORISSA, WEST BENGAL, ASSAM, NORTH EASTERN STATES	Early maturity, medium large seed, high shelling %, more 3-seeded pods
TLG 45	2007	MAHARASHTRA	Large seed, medium maturity
TG 38	2006	Orissa, West Bengal, Assam, North Eastern states	High shelling %, more 3-seeded pods, more round seeds, stem rot tolerance
TPG 41	2004	All India	Large seed, medium maturity, 20 days fresh seed dormancy, high oleic acid.
TG 37A	2004	Haryana, Rajasthan, Punjab, Uttar Pradesh, Gujarat, Orissa, West Bengal, Assam, North Eastern states	High yield, smooth pods, wider adaptability, collar rot and drought tolerance
TG 26	1996	Gujarat, North Maharashtra, Madhya Pradesh	Earliness, high harvest index, 20days seed dormancy, smooth pods, salinity tolerance
TKG 19A	1996	Maharashtra	Large seed size, 30 days fresh seed dormancy
TG 22	1994	Bihar	Medium large seed, 50 days fresh seed dormancy
TAG 24	1992	Maharashtra, Orissa, Karnataka, Rajasthan, West Bengal	Semi-dwarf, earliness, high yield, high partitioning %, wider adaptability
Somnath (TGS 1)	1991	Gujarat	Large seed, semi-runner type
TG 3	1987	Kerala	Less number of branches.
TG 17	1985	Maharashtra	No secondary branches, 30days seed dormancy.
TG 1	1973	Maharashtra	High yield, large seed, more branches, 50 days seed dormancy
Sunflower			
TAS-82	2007	Maharashtra	Black seed coat, tolerant to drought
Soybean			
TAMS 98-21	2007	Maharashtra	High yielding, resistant to bacterial pustules, *Myrothecium* leaf spot, soybean mosaic virus diseases
TAMS-38	2005	Maharashtra	Early maturing, resistant to bacterial pustule, *Myrothecium* leaf spot
Mustard			
TPM-1	2007	Maharashtra	Yellow seed Tolerant to powdery mildew
TM-2	1987	Assam	Appressed pod
TM-4	1987	Assam	Yellow seed

Mungbean (Green gram)			
TM 2000-2	2010	Chhattisgarh	Suitable for rice fallows and resistant to powdery mildew
TM-96-2 (Trombay Pesara)	2007	Andhra Pradesh (*rabi* and summer) and rice fallows	Resistant to powdery mildew and *Corynespora* leaf spot
TJM-3	2007	Madhya Pradesh	Resistant to powdery mildew, yellow mosaic virus and *Rhizoctonia* root –rot diseases.
TMB-37	2005	Eastern Uttar Pradesh, Bihar, Jharkhand, West Bengal, Assam	Tolerant to yellow mosaic virus
TARM-18	1995	Maharashtra	Resistant to powdery mildew
TARM-1	1995	Maharashtra, Gujarat, Madhya Pradesh, Andhra Pradesh, Kerala, Karnataka, Tamil Nadu, Orissa	Resistant to powdery mildew
TARM-2	1992	Maharashtra	Resistant to powdery mildew
TAP-7	1983	Maharashtra, Karnataka	Tolerant to powdery mildew
Pigeonpea			
TARA TJT- 501	2014 2009	Maharashtra Madhya Pradesh, Gujarat, Maharashtra, Chhattisgarh	High yielding High yielding, early maturing, tolerant to *Phytophthora* blight
TT-401	2007	Madhya Pradesh, Gujarat, Maharashtra, Chhattisgarh	High yielding, tolerant to pod borer and pod fly damage
TAT-10	1985	Maharashtra	Early maturing
TT-6	1983	Madhya Pradesh, Gujarat, Maharashtra, Karnataka, Kerala, Andhra Pradesh	Large seed
Urdbean (Black gram)			
TU-40 TU 94-2	2013 1999	Andhra Pradesh, Karnataka, Tamil Nadu and Orissa Andhra Pradesh, Karnataka, Kerala, Tamil Nadu	Resistant to yellow mosaic virus and leaf spot disease. rice fallows Resistant to yellow mosaic virus
TAU-2	1992	Maharashtra	High yielding
TPU-4	1992	Maharashtra, Madhya Pradesh	Large seed
TAU-1	1985	Maharashtra	Large seed
Cowpea			
TRC-77-4 (Khalleshwari)	2007	Chhattisgarh *(rabi*)	Suitable for rice based cropping system
Rice			
Hari	1988	Andhra Pradesh	Slender grain type
Jute			
TKJ-40	1983	Orissa	High yielding

Abbreviations: A : Akola, AM : Amaravathi, B: Bikaner, D: Dharwad, G : groundnut, J : Jawahar, K: Konkan, K: Kendrapara, L : Latur, M : mung/mustard, MB: mungbean, P : Phule/Phaseolus (TAP-7), R: Raipur, R: Resistant (TARM-18)/Rabi (TARM-1,2), S : soybean/ sunflower, T : Trombay, T : tur, U : urid.

Recent developments and Challenges in Radiation Processing of Food

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ABSTRACT
Radiation processing of food involves controlled application of energy from ionizing radiations such as gamma rays, electrons and X-rays on food to achieve desired objectives. Gamma rays and X-rays are short wavelength radiations of the electromagnetic spectrum. Approved sources of gamma radiation for food processing are radioisotopes (Cobalt-60 and Caesium-137), electron beam (up to 10 MeV) and X-rays (up to 5 MeV). Later two is generated by machines using electricity. Gamma radiation can penetrate deep into food materials and bring about desired effects. Irradiation works by disrupting the biological processes that lead to decay. In their interaction with water and other molecules that make up food and living organisms, radiation energy is absorbed by the molecules they contact. The interaction of radiation and radiolysis products of water with DNA impair reproducing capacity of microorganism and insects as well as the ability of underground vegetables such as potato and onion to sprout.

I RADIATION PROCESS FOR FOOD

(a) Processing Facilities- Radiation processing of food is carried out in an irradiation chamber shielded by 1.5 - 1.8 m thick concrete walls. Food, either pre-packed or in-bulk, placed in suitable containers is sent into the irradiation chamber with the help of an automatic conveyor. The conveyor goes through a concrete wall labyrinth, which prevents radiation from reaching the work area and operator room. When the facility is not in use the radiation source is stored under 6 m deep water. The water shield does not allow radiation to escape into the irradiation chamber, thus permitting free access to personnel to carry out plant maintenance when required. For treating food, the source is brought to the irradiation position above the water level after activation of all safety devices and preventing human entry. The goods in carriers or tote boxes are mechanically sent inside and positioned around the source rack and are turned around their own axis, so that contents are irradiated on both the sides. The absorbed dose is determined by the residence time of the carrier or tote box in irradiation position. Absorbed dose is checked by placing dosimeters at various positions in a tote box or carrier.

(b) Food production and post-harvest losses in India- As per USDA database India ranked second in rice (approx. production 204 million MT), and wheat production (approx. 95 million MT) after China. India is the major producer of maize after USA, China, and Brazil, and also the leading producer of spices (approx. 1.5 million MT) (UN, FAO). Similarly it ranked second in fruits, and vegetables production after China. Yearly about 21 million MT of wheat i.e. approx. 22% of its total production rots in India. About 40% of India's fresh fruit and vegetables (equivalent to $8.3bn) perishes before reaching consumers (FAO).Cold storage facilities are available for just about 10% of India's perishable produce and are mostly used for potato. In developing countries 40% of losses occur at post-harvest and processing levels while in industrialized countries almost similar quantum of losses happen at retail and consumer levels.

(c) Food Safety- Microbial contaminations can occur at every level of food processing chain: at primary production stage (due to manure, soil, irrigation- water, worker etc.), processing stage (worker, conveyer belt, washing water), and retail or consumption stage (cross-contamination, cutting bed, improper storage). Bacteria like *Clostridium botulinum, E. coli O157:H7, L. monocytogenes, Salmonelle spp., Shigella spp., Staphylococcus spp., Vibrio cholerae, and Yersinia enterocolitica;* Viruses such as Norovirus, and HepatitisA, and protozoa like *Cryptosporidium* spp., and *Cyclospora* spp. have been reported to be associated with major fruits and vegetables associated outbreaks worldwide.Leafy greens like spinach are the most likely culprit in food borne illnesses as internalization of bacteria has been reported in such commodities. To address safety concern US FDA issued Final Rule on Approval of Irradiation of Spinach and Iceberg Lettuce (Food Chemical News, February 25, 2014). The proposition that *E-coli* testing of imported fresh fruits and vegetables should be mandatory was unanimously opined by the scientific panel on Contaminants or Biological Hazards of the Food Safety and Standards Authority of India (FSSAI) too, in its recent meeting discussing Biological Hazards, in New Delhi. U.S. Food and Drug Administration has recently also released a draft risk assessment on the levels of contaminants in spices. Approx. 12 percent of spices imported to the U.S. were found to be contaminated with insects and rodent excrement, and approx. 6.6 percent of spices were contaminated with *Salmonella*. Other pathogens found included

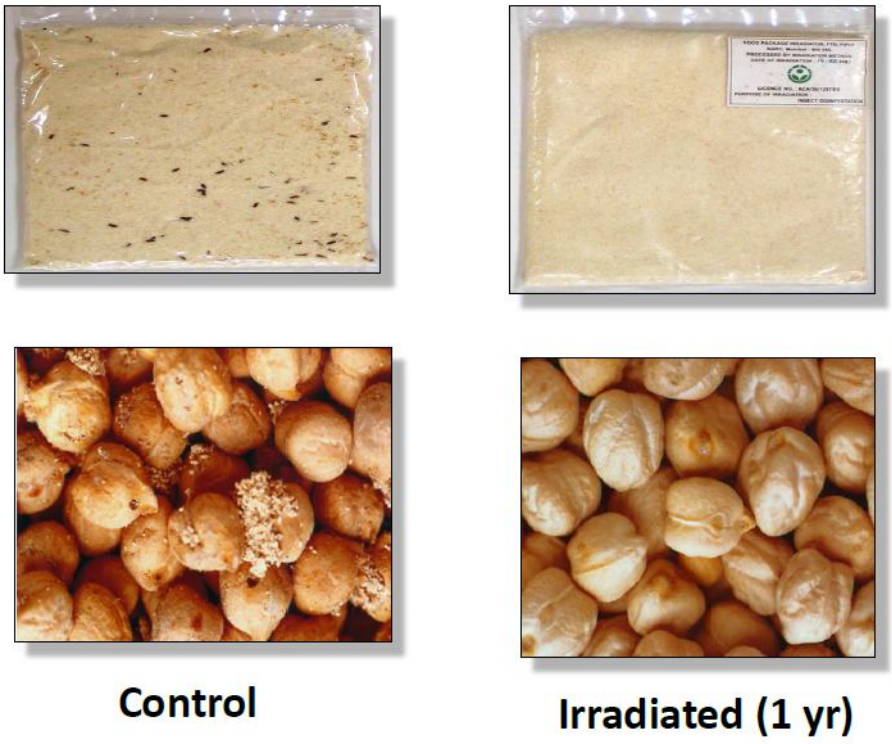

Fig 1 Insect Disinfestations of Cereals & Legumes

Clostridium perfringens, *Shigella* and *Staphylococcus aureus*

(d) Applications of radiation processing of foods- Major benefits achieved by radiation processing of food includes inhibition of sprouting of tubers and bulbs, disinfestations of insect pests in agricultural commodities, delay in ripening and senescence of fruits and vegetables, destruction of microbes responsible for spoilage, and elimination of pathogens and parasites of public health importance.

(e) Effect of radiation processing on food quality-Irradiation produces very little chemical changes in food. Physical properties of food were also not found to be affected by the radiation treatment. The majority of changes due to radiation processing of food are similar to those by other preservation methods like heat. The radiolytic products and free radicals produced in irradiated food are identical to those present in foods subjected to treatment such as cooking and canning. None of the changes known to occur have been found to be harmful. Highly sensitive scientific tests carried out during the past 50 years have failed to detect any new chemical product in radiation processed foods. The safety and wholesomeness of the technology was endorsed in 1981 by international bodies like World Health Organization, Food & Agricultural Organization, International Atomic Energy Agency, and in 1983 by the Codex Alimentarius Commission. Food Safety and Standards Authority of India (FSSAI) has also endorsed this technology. The irradiation process involves passing of food through a radiation field allowing the food to absorb desired radiation energy but the food itself never comes in contact with the radioactive material and hence the irradiation process does not make food radioactive. There is no evidence to suggest that free radicals or radiolytic products affect the safety of radiation processed food.

II ECONOMICS OF FOOD RADIATION PROCESSING

(a) Cost of Setting up Facilities - Estimated cost for setting of a commercial radiation processing facility comes in the range of Rs. 10-12 crores excluding land cost. However, the processing cost is quite cheaper. Radiation treatment cost ranges from Rs.0.25 to 0.50/ kg for a low dose applications such as sprout inhibition of potato and onion and insect disinfestations in cereals and pulses; and Rs.1-3/kg for high dose applications such as treatment of spices for microbial decontamination. The costs could be even further brought down in a multipurpose facility treating a variety of products around the year. In many cases, extended shelf-life offsets the extra cost.

Fig 2 Insect Disinfestations & Microbial Hygienization of Spices

Processing also brings benefits to consumers in terms of availability, storage life, distribution, and improved hygiene of food. Irradiation can have a stabilizing effect on market price of commodities by reducing storage losses resulting in increased availability of produce.

(b) Current Status- In countries, such as France, The Netherlands, South Africa, United States, Thailand and China, radiation processed foods such as strawberries, mango, banana, shrimp, frog legs, chicken, spices, and fermented pork sausages are sold on regular basis on the market shelf. More than 23 countries are irradiating food for processing industries and institutional catering. These radiation processed food items are labeled with radura logo to indicate the treatment and its purpose. Recent development in the area of food irradiation in India include harmonization of food irradiation rules with international regulation through adaptation of class wise clearance of irradiated food items by the Atomic Energy (Radiation processing and Allied Food Products) Rules, 2012 by the Food Safety and Standards Authority of India (FSSAI). Twelve food irradiation plants have been commissioned till date in the private sector. Two plants set by Government of India (Radiation Processing Plant, Vashi, Navi Mumbai; and KRUSHAK, Lasalgaon, Nashik) are also operational. Volume of food irradiated in India has been steadily increasing. A total of approx. 31,000 tons of produce have been irradiated by Radiation Processing Plant, Vashi, Navi Mumbai till 2014. Irradiated mango is being exported to USA since 2007.

III RECENT R&D FINDINGS INDICATING ADDITIONAL APPLICATIONS OF RADIATION PROCESSING

Shelf-life extension of 10 days was achieved for button mushroom (*Agaricusbisporus*) by gamma irradiation (2 kGy) and low temperature (10°C) storage. Sugarcane juice was preserved for 35 days by addition of permitted preservatives, gamma irradiation (5kGy) and storage at 10°C. Safety of leafy vegetables can be ensured by radiation processing with extended shelf life of more than two weeks. A combination process including radiation treatment can ensure safety and also extend the shelf life of sweet corn kernels up to one month. Dried water chestnut can be preserved by radiation processing for more than one year. Safety of herbals and tea can also be ensured by radiation treatment.

IV SPECIAL PURPOSE FOODS

Several new ready to eat (RTE) food products have also been developed for different target groups such as persons affected by natural calamities, defence personnel, or immune-compromised patients. Many food items were developed by India using radiation processing during IAEA CRP(D6.20.09) on “The Development of Irradiated Foods for Immuno-Compromised Patients and other Potential Target Groups”. Also radiation doses, treatment and storage conditions were standardized for these products. The products include Naso-Gastric Liquid Feed formulation (NGLF), Low Cost Enteral Food (LCEF),

Intermediate Moisture (IM) Papaya Cubes, Irradiated honey, Stuffed Baked Food (SBF, Local

Fig 3 Phytosanitary Treatment for Export

name: Litti), MethiParatha, PuranPoli, Vegetable pulav, and RTE meat products (Chickentikka, Chicken pahadikabab, Chikenparatha, Chikenpulav, and Baked chiken dumpling). The products were found to retain wholesomeness and quality attributes. Two of these products (NGLF, and LCEF) were developed in association with Tata Memorial Hospital mainly for immune-compromised patients. Rest other products are for use during natural calamities, and defence personnel placed at remote places. These products are equally good for routine consumption by an individual.

V SAFETY OF FOOD IRRADIATION FACILITY & CHALLANGES

Gamma irradiator does not undergo meltdown, as Cobalt-60 is not a fissile material and no neutrons are produced unlike in a nuclear reactor. Also no environmental contamination due to leakage of radioactivity can occur because the radioisotope is doubly encapsulated in stainless steel tubes.Laws and regulations enacted by Atomic Energy Regulatory Board govern operations of irradiators. The plants must be approved by the Government of India before construction, and are subject to regular inspection, safety audits, and other reviews

Shelf-stable Litti (1 yr of storage at room temperature)

Fig 4: Radiation Processing of Foods and Applications.

to ensure that they are safely and properly operated. Cobalt-60 and Caesium-137 which are used as the source of radiation energy decay over many years to nonradioactive Nickel and Barium, respectively.

When the radioactivity falls to a very low level the source pencils are returned to the supplier who has the provision of storing them.

It is quite challenging but utmost needed to expand and strengthen the collaborations, with Food Corporation of India, Ministry of Food Processing, National Disaster Management Authority, Defence authorities, hospitals, and commercial as well as institutional food suppliers. This will ensure the eventual adoption and integration of irradiated foods into the supply chains and will help promote commercialization and widespread use of the technology. It is also required to develop appropriate outreach and education materials for target audiences including family members, medical professionals, private investors, community groups, NGO's, regulatory agencies, financial and legal industries. Private entrepreneurs should be encouraged to establish more food irradiation facilities to ensure the large scale availability of the irradiated food in the market so that consumers get an option.

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Insurance Industry in India: A Journey from British India to Independent India

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ABSTRACT
Insurance has long history in India. The insurance process has been developed to defend the interests of common man from ambiguity by giving some assistance. The insurance policy is more important. The insurance provides protection and defense against the loss on an exacting occasion. The insurance sector is divided in two parts life and general or non-life Life insurance deals with only human lives and non-life deals with other than human life. In 1818, a British company called Oriental Life Insurance setup the first insurance firm in India followed by the Bombay Assurance Company in 1823 and the Madras Equitable Life Insurance Society in 1829. The government created a specific Board to deal with promotion of FDI in India and to be the sole agency to handle matters related to FDI. Private insurance has able to obtained 13 per cent of the life insurance market and 14 per cent of non-life market within very short period of time. However, there is still an enormous demand of insurance in market. The objective of this paper is to study the growth and progress of insurance industry in India.

Keywords: General Insurance, Insurance, IRDA, and Life Insurance Corporation of India.

I INTRODUCTION

The concept of insurance has been a long history in India. Overseas traders practised a system of marine insurance. The joint family system which is a part of Indian culture was a technique of social insurance to the members of the family. In Indian Constitution division of powers between the Centre and the States are present, which is the feature of federal system. The Central Legislature is empowered to regulate the insurance industry in India and hence the law in this regard is uniform throughout the territories of India.

Global insurance premiums grew by 2.7 percent in inflation-adjusted terms in 2010 to $4.3 trillion, climbing above pre-crisis levels. The return to growth and record premiums generated during the year followed two years of decline in real terms. Life insurance premiums increased by 3.2 percent in 2010 and non-life premiums by 2.1 percent. Insurance regulators were introduced in 2014 for increasing ability to scrutinize entire insurance group's financial condition. Direct regulation of non-insurance entities is still away from the reach of the legal authority of most regulators. It is important to improve it (Insurance, 2015).

II MEANING OF THE CONCEPT

Insurance is the reasonable move of the risk of a loss, from one unit to other in exchange for payment. It is a form of risk management primarily used to hedge against the danger, uncertain loss. Insurance involves pooling funds from many insured entities to pay for the losses that some may incur. The insured entities are protected from risk for a fee, with the fee being dependent upon the frequency and severity of the event occurring. In order to be an insurable risk, the risk insured against must meet certain characteristics (Insurance, 2015).

Health insurance can be defined as a way to distribute the financial risk associated with the variation of individuals' health care expenditures by pooling costs over time through pre-payment and over people by risk pooling (Acharya, 2012). Investment income is a key determinant in the calculation of premium rates for any insurance company under the various insurance policies/schemes and for declaration of bonus by life insurers. It is a core function of an insurance company, which cannot be outsourced by an insurer (Bhimrao, 2011).

III LITERATURE REVIEW

Krishnamurthy (2005) in his paper "Insurance Industry in India: Structure, Performance, and Future Challenges" found that insurance companies are playing vital role for offering products. They are also facing various challenges like demand conditions, competition, product innovations, delivery and distribution systems, use of technology, and regulation. From Venkatesh (2013) article "A Study of Trend Analysis in Insurance Sector in India", we known Indian insurance companies are growing very fastly. Population of India is increasing rapidly and also raising the purchasing capacity. It is showing that in future there will be huge demand. Srivastava et al (2012) in their report "Indian like insurance industry: The changing trends" concluded that insurance industry contributes in employment generation and also increasing the social security. The progress of the sector in India has been exceptional. The insurance industry also changing as the market is changing.

Dash & Pany (2013) in their paper "Insurance industry in India: Prospects and challenges" discuss about the development of insurance industry in India. According to them life Insurance potential can be examined by Insurers in details from three angles i.e. in terms of insurable population, savings and consumption expenditure. E-Commerce and market conducts are two important areas which will strengthen the relationship between companies, consumers and regulators. In most of the countries, Insurance industries have not been allowed to operate in a free and competitive environment and are saddled with avoidable restrictions. The market forces should be allowed to operate and determine as to which are the best products and optimum price in the interest of the consumers. Singh & Gautam (2014) in their paper "Foreign Direct Investment and Indian Insurance Industry" investigate the Indian insurance industry and review current policy and regulations with a viewpoint of foreign investors so as to gain an understanding of the current position on FDI, as well as an overview of the Indian Policy and Regulatory Environment. Liberalization of insurance creates an environment for the generation of long term contractual funds for infrastructural investments.

In reveals from Bedi & Singh (2011) paper "An empirical analysis of life insurance industry in India" that life insurance companies in India were faced various constrains during its journey. There are various favourable factors helps for its growth. This paper also analyse the overall performance of Life Insurance Industry of India between pre and post economic reform era. From Kannan (2000) paper "A Study on the Growth of Indian Insurance Sector" we can say that Insurance Act, 1938, the Life Insurance Corporation Act, 1956 and General Insurance Business (Nationalisation) Act, 1972, Insurance Regulatory and Development Authority (IRDA) Act, 1999 and other related Acts are the basic acts which govern the insurance sector. For large untapped market and popularity, insurance industries have good future. Today it stands as a business growing at the rate of 15-20 per cent annually. With combination with banking sector, it contributes seven percent. Considering the all things it can say that growth of insurance sector is not upto expectation. In India yet 80 percent people do not have insurance.

IV TYPES OF INSURANCE

The insurance sector is divided in two parts life and general or non-life Life insurance deals with only human lives and non-life deals with other than human life. Life insurance contracts can be for short periods (for example, accidental death) or very long periods (for example, whole of life). In consequence life insurance can intrinsically include a savings element, and in many late transition and industrial countries this component dominates funds flows in the sector (Lester, 2009).

Life insurance is a contract between an insured (insurance policy holder) and an insurer or assurer, where the insurer promises to pay a designated beneficiary a sum of money in exchange for a premium, upon the death of the insured person. Life policies are lawful agreements and the terms of the agreement describe the restrictions of the insured events (Life Insurance, 2015). General insurance or non-life insurance policies, including automobile and homeowners policies, provide payments depending on the loss from a particular financial event. General insurance is typically defined as any insurance that is not determined to be life insurance. It is called property and casualty insurance (General Insurance, 2015).

(a) Importance of Insurance- Insurance can have different impact on people. It provides more safety to the family. It plays vital role in nuclear family, means small family. In joint family, other members of the family help when it needs by any family member, but it not possible in small family. Health insurance, life insurance and other general insurance are more popular in small family. It helps the family if any incidence happens against the earning member of the family (Insurance, 2015).

Natural calamities are an important feature in every country for global warming. Agriculture is affects more by it directly. Many banks and other institution are running various agriculture insurance schemes. Government sector is more ahead here as we compare with private sector. As agriculture and industry are interconnected, i.e. agriculture is the source of raw materials, so industries are also affected for it (Francis, 2015).

Health is an important constituent of human resource development. Good health is real wealth of society. It not only increases human efficiency but also decreases private and public expenditure on sickness and diseases. Health has been declared as a fundamental human right. Healthcare services help to reduce infant mortality rate, check crude death rate, keep diseases under control and raise life expectancy. World development report 1993 stated, Improved health contributes to economic growth in four ways: It reduces production losses caused by worker illness, it permits the use of natural resources that had been totally or nearly increasable because of disease, it increases the enrolment of children in schools and makes them better able to learn, and it frees for alternative uses resources that would otherwise have to be spent on treating illness. Health insurance can provide financial protection to households in the event of

health shock and can reduce catastrophic out-of-pocket expenditure on health care (Yellaiah, 2013).

Having health insurance is important for several reasons. Uninsured people receive less medical care and less timely care, they have worse health outcomes, and lack of insurance is a fiscal burden for them and their families. Moreover, the benefits of expanding coverage outweigh the costs for added services. Safety-net care from hospitals and clinics improves access to care but does not fully substitute for health insurance.

(b) Insurance Industry in British India - In India, insurance has a deep-rooted history. It finds mention in the writings of Manu, Yagnavalkya and Kautilya. In 1818, a British company called Oriental Life Insurance setup the first insurance firm in India followed by the Bombay Assurance Company in 1823 and the Madras Equitable Life Insurance Society in 1829 (Srivastava et. al. 2012). Government of India started publishing returns of Insurance Companies in India in 1914. The Indian Life Assurance Companies Act, 1912 was known as the first statutory assess to control life dealing. In 1928, the Indian Insurance Companies Act was enacted to enable the Government to collect statistical information about both life and non-life business transacted in India by Indian and foreign insurers including provident insurance societies. Insurance Act, 1938 with comprehensive provisions for effective control over the activities of insurers was introduced in 1938 for protecting the interest of the people (Venkatesh, 2013).

General insurance on the other hand also has its origins in the United Kingdom. The first general insurance company Triton Insurance Company Ltd. was promoted in 1850 by British nationals in Calcutta. The first general insurance company established by an Indian was Indian Mercantile Insurance Company Ltd. in Bombay in 1907. Eventually, with the growth of fire, accident and marine insurance, the need was felt to bring such kinds of insurance within the purview of the Act of 1912 (Mahtani, 2002).

(c) Growth of Insurance Industry since Independence- Insurance business gives advantage to the economic activity of the nation and added social security among the people. The growth of the insurance sector in India has been phenomenal. The insurance industry has undergone a massive change over the last few years and the metamorphosis has been noteworthy (Srivastava et. al. 2012). Insurance in India started without any regulations in the nineteenth century. After the independence, the Life Insurance Company was taken by government in 1956, and then the general insurance business was taken by government in 1972. The LIC had monopoly till the late 90swhen the insurance sector was reopened to the private sector. The government created a specific Board to deal with promotion of FDI in India and to be the sole agency to handle matters related to FDI. The 'Foreign Investment Promotion Board' (FIPB) as it is known, is chaired by the Secretary Industry (Department of Industrial Policy & Promotion or DIPP) within the office of the Prime Minister. Its key objectives are to promote FDI in India with investment promotion activities both domestically and internationally by facilitating investment in the country via international companies, NRIs (non-resident Indians) and other forms of foreign investors (Singh & Gautam, 2014).

Life Insurance Corporation of India (LIC) is an Indian owned insurance group and investment company headquartered in Mumbai. It is the major insurance corporation in India. The company was founded in 1956 when the Parliament of India passed the Life Insurance of India Act that nationalised the private insurance industry in India. Eventually, the Parliament of India passed the Life Insurance of India Act on June 19, 1956 creating the Life Insurance Corporation of India, which started operating in September of that year. It consolidated the life insurance business of 245 private life insurers and other entities offering life insurance services, this consisted of 154 life insurance companies, 16 foreign companies and 75 provident companies. There are various products that offer by LIC, i.e. insurance plans, pension plans, unit-linked plans, special plans and group schemes. Today, the LIC has 8 zonal offices, around 113 divisional offices, 2,048 branches and 992 satellite offices and corporate offices (Life Insurance Corporation of India, 2015).

There are various insurance acts in India which governs the insurance sector, like as Insurance Act, 1938, the Life Insurance Corporation Act, 1956 and General Insurance Business Act, 1972, Insurance Regulatory and Development Authority (IRDA) Act, 1999 and other related Acts (Bhimrao, 2011). GIC of India is the sole reinsurance company in the Indian insurance market that have more than four decades experience. After a process of mergers and consolidation, It was re-organized with four fully owned subsidiary companies: National Insurance Company Limited, New India Assurance Company Limited, Oriental Insurance Company Limited and United India Insurance Company Limited (General Insurance Corporation of India, 2015).

Life Insurance is growing rapidly from 2000, because government allows private sector investment upto 26 percent. All private life insurance companies at that time were taken over by LIC. As number of private players are increasing and it's reduce the role of LIC in the market. Life insurance policy in India is growing rapidly ever since the sector opened up for the private and foreign players. The industry is in the

throes of competitive market forces. Unlike several industries like telecommunication and oil industry, insurance is not a high capital cost industry (Thakur, 2014).

(d) Health Insurance Sector in India- Health insurance can be defined in very narrow sense where individual or group purchases in advance health coverage by paying a fee called premium. Health insurance in India is considered same as "hospitalization", where the policy covers the hospitalization expenses. The expenses for hospital bed, nursing, surgeon's fees, consultant doctor's fees, cost of blood, operation theatre charges are all covered. Certain diseases which are mentioned in the policy's terms and conditions shall be excluded from coverage or may be covered only after one or two years of the policy issue date. Health insurance is the most emerging sector in India nowadays due to increasing rates of illness and diseases and high expenses incurred in hospitalization and treatments for these diseases (Aggarwal et. al. 2013).

Given that most employment is informal in developing countries, governments are likely to manage compulsory insurance in the formal sector, with limited avenues to cross-subsidize the non-formal sector. The state is likely to offer insurance on a voluntary basis to the non-formal sector where the bulk of the poor work. The prime welfare objectives of social health insurance are to: (i) prevent large out-of-pocket expenditure; (ii) provide universal healthcare coverage; (iii) increase appropriate utilization of health services; and (iv) improve health status. Because of the widespread interest in expanding health insurance coverage, there has been a parallel interest in evaluating the impact of health insurance programmes in terms of their effects on utilization, out-of-pocket spending and health outcomes (Acharya, 2012).

The health sector in India is at the crossroads today. In line with economic progress and liberalization, Indian states are pushing for reforms in the healthcare sector. The private health sector's market size in India is enormous. It contributes to almost 4.2 percent of GDP of India's total health expenditure (5.1 percent of GDP). The signing of the Comprehensive Economic Cooperation Agreement (CECA) by India and Singapore in June 2005 paves the way for increased business and investment opportunities for Singapore companies in the Indian health sector. Recent healthcare utilization surveys show that private health care providers contribute to 60 percent of India's curative health services needs. The Apollo Hospital Group, which is the acknowledged leader in world-class private healthcare in India, currently carries out preventive check-up on about 300 people daily. Medical-related infrastructure development, led by private health care providers, is expected to grow around 13 per cent annually by 2015. This will inevitably lead to an increase in the demand for medical equipments, instruments and hospital supplies in India. India offers much potential in the private healthcare market, and in the pharmaceuticals and insurance sectors (Mathiyazhagan, 2005).

Most of the insurance programmes have been started as a reaction to the high health care costs and the failure of the government machinery to provide good quality care. The objectives range from providing low cost health care to protecting the households from high hospitalization costs. BAIF, DHAN, Navsarjan Trust and RAHA explicitly state that the health insurance scheme was developed to prevent the individual member from bearing the financial burden of hospitalization. Health insurance was also seen by some organisations as a method of encouraging participation by the community in their own health care. In recent years, community health insurance (CHI) has emerged as a possible means of: (i) improving access to health care among the poor; and (ii) protecting the poor from indebtedness and impoverishment resulting from medical expenditures. The World Health Report 2000, for example, noted that prepayment schemes represent the most effective way to protect people from the costs of health care, and called for investigation into mechanisms to bring the poor into such schemes (Devadasan et. al, 2004).

Health sector in India falls under both centre and state government. From the initial state government plays vital role for development of health sector. Central Government Health Scheme (CGHS) and Employees State Insurance Scheme (ESIS) are most important scheme in this direction. Various specialty insurance programme was introduced by LIC in 1993 which covered medical expenses for only four dreaded diseases. The GIC's Jan Arogya Bima Policy is a medical reimbursement scheme and its annual premium is Rs. 70 for the youngest people age group as against the coverage limit of Rs 5,000 per year (Ellis et al. 2000).

The first health insurance in 1986, under the name mediclaim was started by government insurance company. Mediclaim is a compensation base insurance for hospitalization. Outpatient treatments are not cover under it. Mediclaim has provided a model for health insurance for the middle class and the rich. It covers hospitalization costs, which could be catastrophic. But given the premium is on higher side it as remained limited to middle class, urban tax payers segment of the population. There are also problems and negative unintended consequences of this scheme. Over the last several years there have been efforts to develop health insurance by various small NGOs. Some of the prominent among them have been ACCORD in Karnataka, Tribhuvandas foundation, Aga Khan

Health Services, India (AKHSI) and Nav-sarjan in Gujarat, and Sewagram medical college Maharashtra. The privatization of insurance and constitution IRDA envisage improving the performance of the state insurance sector in the country by increasing benefits from competition in terms of lowered costs and increased level of consumer satisfaction (Mavalankar & Bhat, 2000).

Health insurance in India is a growing segment of India's economy. In 2011, 3.9 percent of India's gross domestic product was spent in the health sector. According to the World Health Organization, this is among the lowest of the BRICS (Brazil, Russia, India, China, and South Africa) economies. Policies are available that offer both individual and family cover. Tax deductions facility can avail any person under the Income Tax Act (section 80D). The health insurance sector hovers around 10 percent in density calculations. Lack of competition in the sector is the important factor obstacles before growth of insurance. The Insurance Regulatory Authority of India (IRDA) was introduces for controlling and proper monitoring the insurance sector (Health insurance in India, 2015).

V OPPORTUNITY OF FOREIGN DIRECT INVESTMENT

FDI in the Insurance Industry, as prescribed in the Insurance Act, 1938, is allowed under the automatic route. This will be subject to the condition that Companies bringing in FDI shall obtain necessary license from the Insurance Regulatory & Development Authority for undertaking insurance activities. FDI up to 26 percent in the Insurance Industry is allowed on the automatic route subject to obtaining license from Insurance Regulatory & Development Authority (Singh & Gautam, 2014). Government improved this limit upto 49% recently (Business Standard, March 13, 2015).

VI INSURANCE REGULATORY & DEVELOPMENT AUTHORITY OF INDIA

It is authoritarian and enlargement authority under Government of India for protecting the interest of the investors. It is an important step in history of insurance sector. In the last 10 years of its establishment the insurance sector has seen tremendous growth. It came into effect in the year 1999. This Act removed the exclusive privilege of GIC and its subsidiaries to carry on general insurance business in India. The supervisory role of GIC over the subsidiaries ended and they were made four independent companies.

Mathotra committee on insurance sector reforms recommended throwing it open to private sector in 1994. Following this government of India enacted the IRDA Act, 1999. IRDA is an autonomous authority to control, regulate an develop the insurance sector of India. One of the objectives of setting up was to regulate the investment of funds by insurance companies. The IRDA has practices the pattern of investment to be followed by insurance companies, through the insurance of IRDA (Investments) Regulations, 2000 which were amended in May 2001. The main features of the bill are:

(a) The monopoly of public sector in insurance sector has ended.
(b) This act allows foreign investment upto 26 percent of total share capital of an Indian Insurance group.
(c) The act has given statutory status to Insurance Regulatory and Development Authority set up in 1996.
(d) The minimum solvency margin has been fixed in Rs. 50 crore.

VII CHALLENGES

The Indian insurance industry currently is in a state of instability. After a decade of strong growth, the Indian insurance industry is currently facing severe headwinds owing to: slowing growth, rising costs, deteriorating distribution structure, and stalled reforms. For the Non life sector the problem areas include micro-insurance in non-life widening reach, improved fraud control mechanisms , standardization to reduce claims loss, reducing inefficiencies by revisiting third party administrator (TPA) agreements. Another challenge for the industry is tendency of insurance companies to under price their products to gain an edge over competition, which is also allowing the industry to bleed. Artificial pricing leads to artificially excessive competition. The inadequate development of health related infrastructure in the country is one of the major challenges today for the health insurance sector (Aggarwal et. al. 2013).

VIII CONCLUSION

The subject matter of life insurance is important for human civilization. Most of the insurance policies are combination of savings and security. LIC was established on September 1, 1956, under an Act passed by the parliament with the capital of Rs. 5 crore. It extends help both to new and existing units. The investment policies of LIC are often criticized by many people. It has certainly has favouring large and well to do industrial units under the garb of security. Numbers of companies in life insurance sector are increasing continuously

as government increased the FDI limit from 26 to 40 percent. Market of LIC were decreasing since 2000, because of appearing new private players.

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PET-MRI Instrumentation

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ABSTRACT
Positron emission tomography-magnetic resonance imaging (PET-MRI) is the recent approach to functional and anatomical imaging. The state-of-the-art PET-MRI scanners simultaneously acquire functional PET and anatomical or functional MRI data. As function and anatomy are not totally independent of one another the images to be reconstructed are likely to have shared structures. PET provides metabolic information and the MRI anatomic structure. Thus, the two modalities provide complimentary information, and it has greatly enhanced its clinical applications like imaging in oncology, neurology, and cardiology. This paper gives an overall understanding of PEP- MRI system.

Keywords- PET-MRI, PMIs, APDs, 3DMRIs

I INTRODUCTION

The two imaging modalities can be combined by inserting a PET system into an MRI system and operating them simultaneously for highly accurate spatial and temporal registration. This provides a powerful tool to characterize disease in living subjects. However, this is a difficult instrumentation problem since combining PET and MRI technologies would create substantial mutual interference between the two modalities: The standard PET system design would have a significant electrical interfere with the MRI system's performance, and the latter creates an extremely noisy environment for the former to operate. This requires conductive shielding around the PET components.

II CHALLENGES

There are major concerns while creating a combined PET-MRI system; the first is putting a PET **Emeritus Prof., AISECT University, Bhopal, and Ex-Scientific Officer, BARC, Mumbai* system with photomultiplier tubes (PMTs), which are extremely susceptible to magnetic fields, into a high magnetic field (and having PET detector units that do not interfere with magnetic fields), second, creating attenuation maps for PET images, and third, a proper construct for the PET-MRI system. However with the advancement of technologies PMTs are being replaced with solid state devices.

III PET DETECTORS AND RELATED ISSUES

For combined PET-MRI scanners the photomultipliers are being replaced with solid-state detectors such as avalanche photodiodes (APDs) and Silicon photomultipliers (SiPM) for PET systems. These devices can operate inside the MRI environment. These solid state devices are increasingly replacing the workhorse PMTs not only in PET systems but in many other applications of gamma detection. However simultaneous PET and MRI measurements employ electronic circuits and instrumentation that can interfere in multiple ways with each other.

IV ATTENUATION CORRECTION

Although CT and transmission scans do provide acceptable methods of attenuation correction, they are not as satisfactory, and various MRI-based techniques are also being considered for attenuation correction. However various researchers have provided solutions to the attenuation correction. It may be mentioned that attenuation correction in brain imaging is less challenging than in the torso.

One approach to MRI-based attenuation correction is by using segmentation. In this, a transmission scan is used to generate an attenuation map which is co-registered to the MRI images, and subsequently, the MRI image is segmented into areas with different attenuation values (bone, brain tissue, fluid, air in the paranasal sinuses). This attenuation map is then applied to the PET images.

In brain imaging, these methods have been found to have variations of around 3 and 10% from standard transmission attenuation correction techniques. However most studies have used only a small number of subjects. Data from torso imaging studies is still evolving, and there is a possibility that by using histogram matching and atlas-based approaches, it may be possible to generate MRI-based attenuation maps for torso imaging.

V SYSTEM CONSTRUCTION

The PET-MRI combined system is insert construct system and it involves building a removable PET detector ring that can be placed within the MRI gantry or around the subject when simultaneous acquisition is needed. In this situation, the PET ring must produce minimal disturbance to the magnetic field, the PET detector must be resistant to magnetic field fluctuations or have an external read-out and all parts must be shielded to prevent electromagnetic interference. Various options, which include using optical fibers or APDs, and SiPM are useful from practical point of view.

This system has the advantage of allowing simultaneous PET-MRI acquisition and the opportunity for it to be adapted to any center that already has an MRI system. The drawback, besides developing the technology to create excellent quality images with excessive interference, is a further decrease in the space within the bore of the MRI scanner.

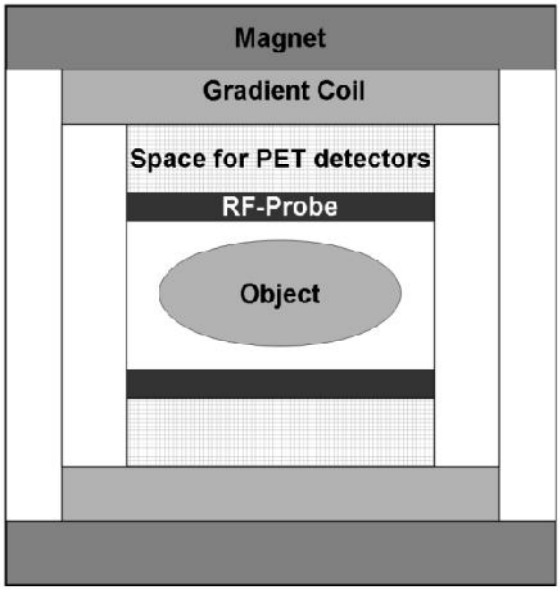

Fig. 1 Typical Topology of PET-MRI System: PET inside MRI System

Fig. 1 depicts a typical PET-MRI system. RF coil is located inside the MRI to do MR imaging. PET is inside the gradient system. The PET allows for the gradient to penetrate.

Fig. 2 depicts three dimensional (3D) view of the topology of PET-MRI System clearly depicting MR magnet, Gradient, PET insert, LSO detector, and position sensitive APD. APD is however is being replaced by SiPM.

Fig. 2 PET-MRI System–3D View

Siemens has pioneered PET-MRI system known as Biograph mMR and it has been commercially available since the last four years. It has been used in oncologic, neurological and other medical imaging. The inherent benefit of the simultaneous acquisition is improved registration allowing optimal localization of PET findings to anatomic imaging and shortened overall imaging times through acquisition of PET and MRI in a single session. This also provides comfort to the patient who has to undergo only one scanning.

Fig. 3 depicts three images viz. PET. MRI. And PET-MRI. It is evident that PET and MRI give complementary images and PET-MRI has both anatomical and functional details.

VI IMPACT ON NUCLEAR MEDICINE COMMUNITY

PET-MRI is an exciting modality which gives us unprecedented simultaneous insight into form and function *in vivo*. While we are well aware and comfortable with the appearance, distribution, and implications of changes in radiotracer distribution, we will now have to deal with one of the most technically challenging imaging modalities, the MRI. The complexities of MRI physics,

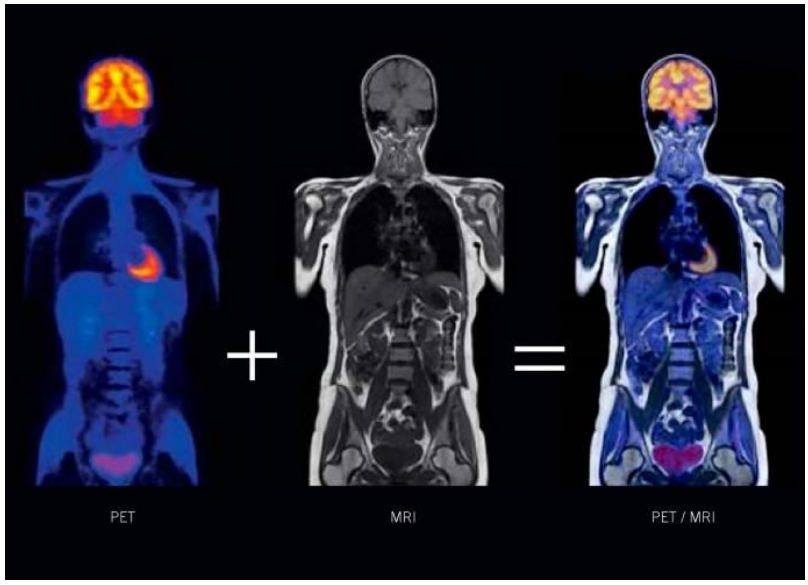

Fig. 3 PET, MRI, PET-MRI Images

MRI sequence optimization, artifacts, the functional aspects of MR imaging, and a huge volume of intricate anatomy, will all soon become the responsibility of the imager. Those who will deliver the best of both worlds will ultimately take the modality into the forefront of research and clinical care. If we are to make a greater impact in this field, now is the time to create the next generation of molecular imagers who will be equipped to deal with these challenges. For a start, we need to understand not just the limitations, but also the strengths of other imaging modalities and start incorporating these more regularly into our daily clinical routine and educational directives.

For example patients with cancer, the PET-MRI can be used for diagnostics and staging, and it can precisely localize the tumor, and a great help for surgical planning. With the PETMRI, patients are exposed to much lower levels of radiation than with the PET-CT. It may be mentioned that PET-CT systems are pretty common compared to PET_MRI systems. PET-MRI thus not only benefits patients who have to undergo multiple scans, but also beneficial to children. Moreover just one appointment for two modalities makes the patient more comfortable.

During the scanning, patients need minimal changes in positions between tests, which allows physicians to compare tests more easily and get information as accurately and quickly as possible.

VII CONCLUSION

PET-MRI is a modality with tremendous potential for combining form and function *in vivo*. The combined scanner is proliferating in clinical practice. Significant challenges still exist before this becomes a routine part of our imaging arsenal. Moreover there is plenty of scope to improve the performance and challenge to engineers and

doctors to work together to realize this potential. Meanwhile, we should be developing an infrastructure that will equip us to cope with the challenges that lie ahead, by learning how other imaging modalities will supplement what we already know.

Hybrid PET/MRI scanners have become commercially available since the last four years, but are not yet widely distributed.

The real challenge of this exciting new technology would be proliferation of its use to masses and it does not seem to be possible in the near future.

Conceptualizations and Issues Related to Development of Algebra

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ABSTRACT
In this paper the conceptual level in the development of algebra and related issues are discussed. The conceptual level and historical phases of development of algebra and their usage is illustrated with the help of examples. In particular, utilizing the concepts is also discussed with implications for the teaching and learning of mathematics.

Keywords: Conceptual understanding, Conceptual level, Development of Algebra.

I INTRODUCTION

The history of sciences and engineering shows that many branches of mathematics have been created in order to meet their abstract, rigorous, and expressive needs. These phenomena may be conceived as that new problems require new forms of mathematics. It also indicates that the maturity of a new discipline is characterized by the maturity of its theories denoted in rigorous and efficient mathematical means.

Algebra students may often demonstrate a certain degree of proficiency when manipulating algebraic expressions and verbalizing their behaviors. Do these abilities imply conceptual understanding? What is a reliable indicator that would provide educators with a relatively trustworthy and consistent measure to identify whether students learn algebraic concepts beyond procedures? How might teachers know when the transition from 'operational' or 'process conception' to 'structural' or 'object conception' takes place? Assessing mathematics students' conceptual understanding is critical for educators to make informed decisions when selecting curriculum, planning instruction and developing an assessment program. These decisions should be supported by strong educational foundations and be rooted in theory that provides sustained basis for understanding how mathematics students construct knowledge and how mathematics can be taught. The multiyear research study described in this paper attempts to answer these questions. This paper introduces a framework for assessing students' levels of understanding of algebra.

Understanding is a logical power manifested by abstract thought. Piaget suggested that understanding in general and in mathematics in particular is a highly complex process of abstraction. He proposed the term reflective abstraction to explain the process of developing conceptual understanding. It can be said that those who have a conceptual understanding grasp the full meaning of knowledge, and can discern, interpret, compare and contrast related ideas of the subtle distinctions among a variety of situations. Conceptual understanding in algebra can be characterized as the ability to recognize functional relationships between *known*, and *unknown*, *independent* and *dependent variables*, and to distinguish between and interpret different representations of the algebraic concepts. It is manifested by competency in reading, writing, and manipulating both number symbols and algebraic symbols used in formulas, expressions, equations, and inequalities. Fluency in the language of algebra demonstrated by confident use of its vocabulary and meanings and flexible operation upon its grammar rules (i.e., mathematical properties and conventions) are indicative of conceptual understanding in algebra, as well.

II ROLE OF GENERALIZATION AND ABSTRACTION IN INITIAL DEVELOPMENT

An orientation to algebraic structure requires a focus on the most general and abstract characteristics of real phenomena, beginning with children's initial class-room encounters with such phenomena. This, in turn, requires the development of voluntary attention. And as is the case with scientific concepts and theoretical learning in general, pedagogical mediation is necessary. This is accomplished in Davydov's program by focusing children on the theoretical characteristics of real objects, objects with which they are familiar, asking them to compare such objects with respect to their length, area, volume, or weight, and to progressively refine such comparisons until they culminate in measurement itself. Small children typically make such comparisons when receiving along with a sibling or friend, a cookie, candy bar, or a glass of juice or cola. What parent is not familiar with the small accusatory finger pointing at the other's handout and asserting that, "his cookie is bigger" or she "has more juice"?

This exploratory research study resonates with past assumptions that students are not developing accurate concept images and concept definitions of abstract algebra concepts. Professors, especially, should find this research useful since many mathematics professors may not know what the students are actually learning or not learning in their classes. Abstract algebra has historically been a course where there exists a mismatch between what the professor assumes students are learning and what knowledge students are actually attaining. Hence, providing professors a snapshot of what students identified as key concepts (or about which they indicated confusion) would be immensely beneficial.

III METHODOLOGY

This research employed a semi-structured interview protocol with both open-ended questions and construction tasks (Patton, 2002; Taylor & Bogdan, 1984; Zazkis & Hazzan, 1999). Each interview was audio recorded and ran approximately 45-60 minutes in length in a private room to ensure confidentiality. After the interviews were complete the audio was transcribed within a week of the interview. Participants were chosen based on recently (within a year or less) being enrolled in the master's level abstract algebra course and being accepted into at least the master's level mathematics graduate program. While undergraduate students typically take abstract algebra, graduate students were chosen to provide an additional level of expertise. Three students (pseudonyms: Andrew, April, and Heather) participated in this research study. Each student had taken three lecture-based abstract algebra courses—an introductory course as an undergraduate and a yearlong sequence of two courses as a graduate student. Since the purpose of this research study is to gain insight into graduate students' perspectives of abstract algebra, one of the central foci of the interview was the creation of concept maps. These maps allowed the participants and researcher to visually understand described relationships between concepts. Novak and Cañas (2008) and Trochim (1989) largely contributed to the overall research design of this activity. First, each participant was given index cards (or post-it notes) and asked to write any important or key concepts of abstract algebra on a card (one per card). When he or she was finished with this task, the participant was asked to explain each concept. Next, participants were asked to visually represent any conceptual relationships between these topics by placing their concept cards on a sheet of poster board and drawing lines or arrows between concepts that have some type of relationship. After each participant completed a concept map, he or she was asked to explain why each line was drawn. Grounded theory was utilized when analyzing the data. Thus, the data was first collected, coded, grouped by concepts, categorized, and then the theoretical results were formulated (Charmaz, 2000). The transcribed interview responses were analyzed thematically (Charmaz, 2000; Patton, 2002; Taylor & Bogdan, 1984) focusing on the students' constructed knowledge of abstract algebra. The perceived significant concepts and connections among topics in the course were explicitly emphasized. This multi-year research study was launched to address and explore the interpretative dimensions of educational phenomena (Bums, 2000; Cohen & Manion, 1992; Merrian, 1988) associated with the assessment of levels of middle school students' understanding of linear relationship with one unknown. The internal validity of this research was achieved by data, methodological, and theory triangulation (Burns, 2000; Cohen & Manion, 1992). Data triangulation was censured by collecting data from different students at different times. Methodological triangulation was achieved through different data collection methods; a comprehensive multifaceted survey and interviews with the students were used to identify issues and themes related to developing conceptual understanding and reducing levels of abstraction. The theory triangulation was related to an epistemological and ontological justification (Merrian, 1988) of the terms representations, adaptation to abstraction level, reducing level of abstraction and conceptual understanding, which are discussed later in the paper from different perspectives. The research inquiries have been addressed through analysis of the survey and analysis of students' thinking process while they were solving problems and explaining their solutions during the interviews.

(a) Instruments and sample- The survey, designed by the researcher and described below, consisted of four interrelated parts. It combined a questionnaire and a set of problems, both related to the concept of one-two-step linear equations with one unknown, which are familiar to middle school algebra students. The actual problems were presented in three different modes: words, diagrams, and symbols. While designing and refining the survey, the researcher conducted three consecutive pilot studies to attain better clarity of the items and directions, to clean up ambiguity in sentences, to check for time of completion, and to address the problems that the students had been experienced when taking the pilot survey (McMillan & Schumacker, 1997). The pilot data were collected from three different groups of middle school algebra students in the districts which administered the final version of the instrument during next years. Each pilot provided feedback which enabled the researcher to revise the items. Scores were analyzed for adequate

distribution for each item in the instrument (p.183). The instrument provided consistent results when repeated (Flower, 1993). Several experts in the field confirmed the content and face validity of the instrument. An inter-item correlation was conducted for each construct to ensure the reliability of the instrument.

(b) Description of the survey and coding system- Part I has 12 items with five optional response scale (always, often, sometimes, rarely, never). The items were aimed to collect information about students' perceptions experiences and attitudes towards different representations (words, diagrams, symbols) when they dealt with algebraic problems in general. All items were broken down into several constructs and scoring codes were clustered around students' preferred mode of representation (for example, the students' perception of pictures/diagrams, numerical symbols, algebraic symbols, multiple representations). In Part II four questions each with three choices asked the students to select the response that most closely reflects their current learning practices and most preferable/ less preferable mode of thinking (mental habits) when solving linear equations with one unknown. While the items in Part I and Part II might seem redundant they provided a basis to ensure consistency and correspondence of the students' responses. In other words, if in Part I a student indicated that he/she needs to draw a picture when solving problems, it was expected that in Part II the student would indicate that he/she is comfortable to think in pictures. Part III illustrated "structurally the same" (Dreyfus & Eisenberg, 1996, p. 268) linear relationship with one unknown posed in three different representations: as a word problem, as a diagram where the unknown number was presented as a line segment, and as an algebraic equation expressed in symbols. Students were not asked to solve the problems and generate solutions, but rather to observe and explain in writing if they recognize the *same relationship* (the sum of two numbers is 28; one number is 10, what is the other number?) presented in three different modes. The coding system for the items in Part III included 4 codes from 0 to 3. The code 0 was assigned if the students made no attempt and left it blank. The code 1 was assigned to the answers which indicated that the students did not recognize (answered 'no') the same relationship presented via three different representations. The code 2 was assigned if the students recognized the relationship presented via three different representations (answered 'yes'), but did not explicitly verbalize their thinking in a clear and coherent way. The code 3 was assigned if the students recognized the same relationship (answered 'yes') and explicitly described the relationship presented via three modes. Part rV consisted of three sets (A, B, and C) of problems that involved linear relationships with one unknown to be solved using one-two-step addition/subtraction and multiplication/division; each set consisted of three problems and the students were asked to solve each problem. For each problem set in the Part IV a coding system was created. Set A had three problems presented in words that described three different linear relationships. The coding consisted of 13 codes from 0 to 12. All possible variations were considered and specifically focused on how the problems were solved. For example, it was noted if the students used only numbers and operations (trial and error, no symbols); whether they set up numerical equations or algebraic equations, or whether they used diagrams. If the diagrams were utilized, they were coded depending on the degree of clarity (obvious, apparent or vague). Set B posed three linear relationships presented in visual form via diagrams. In each diagram numbers and an unknown were illustrated as line segments. The coding system consisted of eleven codes, from 0 to 10, and focused on how the problems presented via diagrams were solved. Each code represented a combination of several variables to document if the students set up numerical or algebraic equation, used correct or incorrect procedure, produced correct or incorrect answer. Set C contained three linear equations with one unknown represented in symbols. The coding system consisted of seven codes from 0 to 6 to account for whether the students solved the problem correctly/incorrectly using trial and error method; whether they used algebraic method i.e., steps, inverse operations. All survey problems were similar in style and level of difficulty. The surveys were analyzed to examine the relationship between students' perceptions and use of multiple representations and students' ability to recognize the same linear relationship between unknown and other elements of a problem presented in different modes: words, pictures, symbols. A constant comparison method (Glaser & Strauss, 1967) was applied to develop categories, compare each category, and look for patterns of similar and distinctive attributes. During the period of four consecutive years four tiers of data were collected from 11 schools in 6 districts, four suburban and two urban with diverse populations of students. The schools were not selected randomly but were approached by the researcher with a request for participation in the study. All the participating schools used the same mathematics curriculum which claims facilitation of reasoning skills and use of multiple representations. The schools administered the survey to all 7 and 8 algebra students *{Nmat* = 753; *Nyeari* = 176; *Nyeari* = 198; *Nyear3* = 207; *Nyear4* -172). Each of the four tiers of surveys was analyzed separately and then compared to look for common themes,

trends, and tendencies. The analysis of the survey led the researcher to organize all surveys in three distinct groups to form three major categories 1, which further induced generation of a hypothesis about the indicators of students ' conceptual understanding of linear relationship with one unknown. The categorization of the surveys guided the selection of the students *(N=24)* for the interviews, eight students from each group. The selection was based on the idea of representative sample from a population, which provides the potential to be able to unitize, categorize and generalize (Glaser & Strauss, 1967; Lincoln & Guba, 1985 Individual surveys from each category were identified and the interviews with selected students were scheduled in their schools. Prior to the actual interview, the researcher met with the teachers of each student to learn about the student' ability level, performance, whether they are English Language Learners, etc. The interviews offered an important layer of evidence about the students' thinking process and the development of conceptual understanding. First, the students were asked to reflect on their survey responses, and then were presented with similar problems to gain more insight into their thinking process. During the interviews the researcher focused on by-product questions such as: How do students conceive symbolic notations as a mathematical language? To what extent and in what way students use different levels of abstraction to demonstrate different meanings of letters and symbols? Is there a relationship between the form of representation the students use (verbal, diagrammatic, symbolic) and the level of their conceptual understanding; in particular, are there signs of potential progress from a procedural to structural conception of linear relationships and its properties. Students' verbal explanations were audio-taped and written notes were collected.

IV CONCLUSION

It is interesting that in 1963, Zankov proposed a reform of school mathematics in Russsia which shares some commonality with the current US reform, in which he advocated an “approach to structuring the learning process in which the emphasis shifts to the pupil’s independent intellectual activity”. (Elkonin 1975, p.37) Although noting that his proposal had been implemented in several schools and some improvement had been reported, Elknonin rejected Zankov’s notion, citing Vygotsky’s position that the *content* of instruction was more important than the method, and arguing that one could not fix the weaknesses of a curriculum with a change in teaching methodology. A theoretical approach to mathematics was essential.

As to be expected, each of the mathematics graduate students had a differing concept image and concept definition of major abstract algebra concepts. When asked to identify these concepts, April and Heather equated the time spent in class to the importance of the concept. April stated, “I think that fields are very important because we spent a lot of time discussing the different properties of fields and the different types of fields… So I felt it was really important.” Likewise, Heather repeatedly defined concept importance by how long the professor discussed it in class. Andrew, on the other hand, relied on his perceived usefulness of a certain concept to determine major concepts. When asked to describe ring theory Andrew stated:

It’s like you encounter rings first from like the first time you encounter math to be like the real numbers. We actually use them in our real life and everything, so in a way like this concept of rings kind of formalizes our understanding of what everything actually means. However, despite the varying concept images associated with concept importance, there were five identified concepts that were mentioned by all three students: groups, rings, fields, Galois Theory, and isometrics with geometric applications. A complete summary of the perceived important concepts of each student is found in Figure 1. In general the mathematics graduate students had difficulty articulating their

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Performance Analysis of Compact Heat Exchanger

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ABSTRACT
Compact heat exchangers are one of the most critical components of many cryogenic components; they are characterized by a high heat transfer surface area per unit volume of the exchanger. The heat exchangers having surface area density (β) greater than 700 m2/m3 in either one or more sides of two-stream or multi stream heat exchanger is called as a compact heat exchanger. Plate fin heat exchanger is a type of compact heat exchanger which is widely used in automobiles, cryogenics, space applications and chemical industries.
The various performance parameters like effectiveness, heat transfer coefficient and pressure drop obtained through experiments is compared with the values obtained from the different correlations. The longitudinal heat conduction through walls decreases the heat exchanger effectiveness, especially of cryogenic heat exchangers, so the effectiveness and overall heat transfer coefficient is found out by considering the effect of longitudinal heat conduction.

Key Words: Heating element, Orifice mass flow meter, Plate fin H.E., T- screw compressor, Test Rig.

I INTRODUCTION

A heat exchanger is a device to transfer heat from a hot fluid to cold fluid across an impermeable wall. Fundamental of heat exchanger principle is heat flow from hot fluid to cold fluid. This heat flow is a direct function of the temperature difference between the two fluids, the area where heat is transferred, and the conductive/convective properties of the fluid and the flow state. This relation was formulated by Newton and called Newton's law of cooling, which is given in Equation (1)

Q = hxAx T…….(1)
Where h is the heat transfer coefficient in W/m^2K A is the heat transfer area in m^2, and T is the temperature difference in K. Figure. 1 shows the basic heat transfer mechanism.

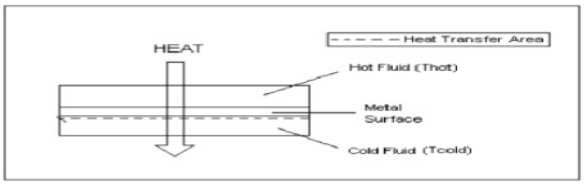


Fig. 1 Basic heat transfer mechanism

Heat exchangers are one of the vital components in diverse engineering plants and systems. So the design and construction of heat exchangers is often vital for the proper functioning of such systems. Exchanger is below 86.9%. On the other hand in aircrafts and automobiles, for a given heat duty, the volume and weight of the heat exchangers should be as min. as possible.

So the main requirement for any heat exchanger is that it should be able to transfer the required amount of heat with a very high effectiveness. In order to increase the heat transfer in a basic heat exchanger mechanism shown below in Figure 1, assuming that the heat transfer coefficient cannot be changed, the area or the temperature differences have to be increased By increasing the temperature difference more than enough will cause unwanted thermal stresses on the metal surfaces between two fluids. This usually results in the deformation and also decreases the life span of those materials. As a result of these facts, increasing the heat transfer surface area generally is the best engineering approach.

Typically, the heat exchanger is called compact if the surface area density (β) i.e. heat transfer surface area per unit volume is greater than 700 m^2/m^3 in either one or more sides of two-stream or multi stream heat exchange. The compact heat exchangers are lightweight and also have much smaller footprint, so they are highly desirable in many applications.

II PROBLEM FORMULATION NEED AND SIGNIFICATION OF PROPOSED RESEARCH WORK

Compact heat exchangers are one of the most critical components of many cryogenic components. Plate fin heat exchanger is a type of compact heat exchanger which is widely used in automobiles, cryogenics, space applications and chemical industries. The plate fin heat exchangers are mostly used for the nitrogen liquefiers, so they need to be highly efficient because no liquid nitrogen is produced, if the effectiveness of heat exchanger is less than 87%.

Plate fin heat exchangers offer several advantages over the other heat exchangers:

(a) Compactness: Large heat transfer surface area per unit volume (Typically 1000 m^2/m^3), is usually provided by the plate fin heat exchanger. This in turn produces a high overall heat transfer coefficient due to the heat transfer associated with the narrow passages and corrugated surfaces.

(b) Effectiveness: very high thermal effectiveness more than 95% can be obtained.

(c)Temperature control: The plate heat small temperature differences. A close temperature approach (Temperature approach as low as 3K between single phase fluid streams and 1K between boiling and condensing fluids is fairly common.),This is an advantage when high temperatures must be avoided.

(d) Flexibility: Changes can be made to heat exchanger performance by utilizing a wide range of fluids and conditions that can be modified to adapt to the various design specifications. Multi steam operation is possible up to 10 streams.
The main disadvantages of a plate fin heat exchanger are:

(i) Limited range of temperature and pressure.
(ii) Difficulty in cleaning of passages, which limits its application to clean and relatively non-corrosive fluids, and
(iii) Difficulty of repair in case of failure or leakage between passages.

III THEORY

Accurate and reliable dimensionless heat transfer and pressure drop characteristics are a key input for designing or analyzing a plate fin heat exchanger. For single-phase flow, the heat transfer coefficient is generally expressed in terms of the Colburn correlation.

H=jCpG(Pr)……(2)

Where **j** called as Coburn factor separates the effects of the fluid properties on the heat transfer coefficient and permits correlations as a function of the Reynolds number (Re). While the j data are expressed as functions of Prandtl number (Pr) and Re, temperature does not appear directly in the expression. Temperature has the only role in determining the thermo-physical properties such as density, viscosity, specific heat and thermal conductivity. Therefore, it is generally recognized that **j** data determined at one temperature / pressure level and expressed in dimensionless form are directly usable at another temperature / pressure level.

Since the plate fin heat exchangers are mainly used for gas to gas heat transfer applications and most of the gases are low density gases, so the pumping power requirement in a gas-to-gas heat exchanger is high as compared to that in a liquid-to-liquid heat exchanger. This fact makes it mandatory to have an accurate estimation of friction characteristics of the heat exchanger surfaces in gas application. The friction factor is defined on the basis of an equivalent shear force in the flow direction per unit friction area. This shear force can be either viscous shear (skin friction) or pressure force (form drag) or a combination of both.

It can be seen that temperature does not appear directly in the expression of friction factor also. Therefore, the f data determined at one temperature /pressure level are directly usable at other temperature / pressure level. But it is seen that j and f are strong functions of fin geometries like fin height, fin spacing, fin thickness etc. Because fins are available in varied shapes, it becomes necessary to test each configuration individually to determine the heat transfer and flow friction characteristics for specific surface. For a given fin geometry, in general, increase in heat transfer performance is associated with increase in flow friction and vice versa. Customarily the ratio of j/f is taken as a measure of the goodness of the fin surface.

Several attempts have been made towards the numerical prediction of heat transfer coefficient and friction factor; but they have generally been unable to match experimental data and several empirical correlations, Generated data from have found extensive application in industry, particularly in less-critical designs. For critical applications, direct experimental determination of **j** and **f** factors for each fin geometry remains the only choice.

In a plate fin heat exchanger the common range of Reynolds number is 500 to 3000 for most of the applications. The Reynolds number is kept low because the hydraulic diameter of the flow passages is generally small due to closely spaced fins and in such conditions operation with low density gases leads to excessive pressure drop unless the gas velocity in the flow passage is kept low.

IV OBJECTIVES OF THE STUDY

The main objective of the present work is to evaluate the performance parameters of a counter flow plate fin heat exchanger through hot testing, which includes-

(i) Design and fabrication of the test rig for plate fin heat exchanger.
(ii) To determine the thermal performance parameters like overall heat transfer coefficient, effectiveness and pressure drop of plate fin heat exchanger through hot testing under balanced flow condition.
(iii) To compare the experimentally obtained values of effectiveness, overall heat transfer coefficient with the values that are obtained from various correlations.

V METHODOLOGY DURING THE TENURE OF THE PLANNING OF WORK

(a) Plate fin heat exchanger: The test section consists of a counter flow plate fin heat exchanger with offset strip fin geometry. This Plate Fin Heat Exchanger was sent here for its performance analysis and to establish the correlation for j and f factors, Figure 3 shows the plate fin heat exchanger with all its dimensions and arrangements of Inlet and Outlet ports. This plate fin heat exchanger consists of offset strip fins. And table.3 provides the details of core dimensions and thermal data respectively. This Project is basically an experimental set-up, which is build up for the thermal performance testing of the plate fin heat exchanger for studying its performance. The procured heat exchanger is an Aluminum Plate Fin Heat Exchanger. This heat exchanger is designed for operating at high pressure and is to be used for low temperature applications. The properties such as effectiveness, NTU, overall heat transfer coefficient, colburn factor j and skin friction co-efficient f etc are calculated to measure its performance.

(b) The component used during experiment:- Twin- screw compressor Our air supply system consists of a Twin screw rotary compressor which is a positive displacement machine that uses two helical screws known as rotors to compress the gas. The rotors comprise of helical lobes affixed to a front and rear shaft. One rotor is called the male rotor and it will typically have three bulbous lobes. The other rotor is the female rotor and this has valleys machined into it that matches the curvature of the male lobes Gas enters at the suction side and moves through the threads as the screws rotate. The meshing rotors force the gas through the compressor and the gas exits at the end of the screw. A 3-5 rotor combination is provided in the compressor so that, the male rotor turns 1.66 times to every one time of the female rotor. Screw compressors have relatively high rotational speed compared to other types of positive displacement machines which make them compact. They have the ability to maintain high efficiencies over a wide range of operating pressure and flow rates and have long service life and high reliability. All these things make them widely acceptable by various industries of the world.

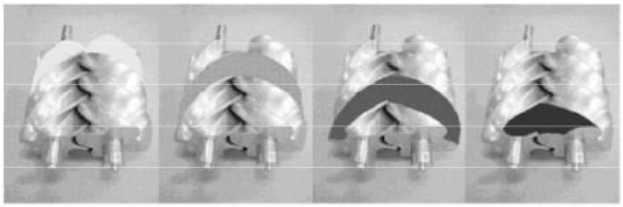


Fig.2 screw compressor

(c) The Compressor specification is given below:

Make : Kaeser (Germany)
Model : BSD 72
Profile of screw : Sigma
Free air delivery : 336 m3 /hr

Suction pressure: : Atmospheric
Maximum Pressure :11 bar
Operating temperature :75-1000c
Motor :37kw, 74amps, 3Φ, 50Hz, 415V±10%, 3000rpm
Oil capacity: 24 L
Cooling: Air

(d) Heating element- This heating element was fully designed and developed in our cryogenics lab the location of the heater is as shown in the P&I diagram. It is basically having a shell and tube type of configuration in which incoming cold side fluid i.e. air enters the equipment and leaves the heater through the series of baffles. Our heater contains seventeen number of aluminum baffles through which a five set of heating tube passes. Load of heater is 1575 W, power source 220/230 V, single phase 50Hz AC Supply.

(e) Resistance temperature detectors (RTDS)
Resistance thermometers also called as resistance temperature detectors (RTD's) or resistive thermal devices are temperature sensors that exploit, the predictable change in electrical resistance of some materials with changing temperature. It is a positive coefficient device, Typical elements used for RTD's include nickel (Ni), copper (Cu), but platinum (Pt) is by far the most common, because it has the best accuracy and stability in comparison to other RTD materials. Platinum is required to fabricate a sensor and making platinum costs competitive with other RTD materials. The RTD's are slowly replacing the use of thermocouples in many industrial applications below 600 ^{0}C, due to higher accuracy and reliability.

RTD's are available with three different lead wire configurations. The selection of a particular configuration depends on the desired accuracy and instruments to be used for the measurement.

(i) Two wire configuration

(ii) Three wire configuration and

(iii) Four wire configuration.

They cannot be used for measurement of temperature above 660 ^{0}C and below - 270 ^{0}C. Also they are less sensitive to small temperature changes.

RTD's are commonly categorized by their nominal resistance at 0 ^{0}C. By far the most common RTD's used in the industry have a nominal resistance of 100 ohms at 0 ^{0}C are called as the PT-100 sensors. The relationship between resistance and temperature is very nearly linear and follows the equation.

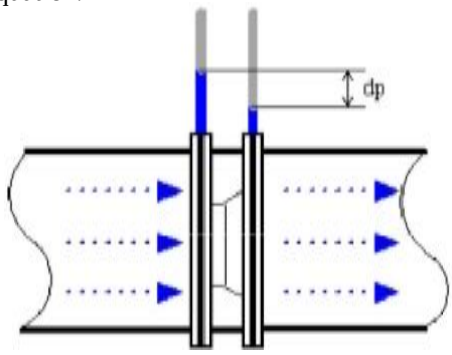


Fig.3 Orifice plate

(f) Orifice mass flow meter- A flow meter or flow sensor is an instrument used in almost all mechanical and electrical instrumentation process to measure the flow rate of liquid or gas. An orifice meter is a device used for measuring the rate of fluid flow. Its working is based on the Bernoulli's principle. The fluid is forced to go through the small hole of varying cross section, the point of maximum convergence actually occurs shortly downstream of the physical orifice, and is called as the point of vena contracta. Both the velocity and pressure of the fluid changes while it passes through the orifice plate. Beyond the vena contracta, the fluid expands and the velocity and pressure change once again. The volumetric and mass flow rates are obtained from the Bernoulli's equation by measuring the difference in fluid pressure between the normal pipe section and at the vena contracta,

The calibration chart is being given below:

(g) Autotransformer or Variac- Variac also called as an Autotransformer is an electrical transformer with only one winding. The auto prefix refers to the single coil acting on itself rather than any automatic mechanism. In an autotransformer portions of the same winding act as both the primary and secondary. The winding has at least three taps where electrical connections are made. Autotransformers are often used to step up or step own between voltages in the 110-117-120 volt range and voltages in the 220-230-240-volt range. We have used two variacs.

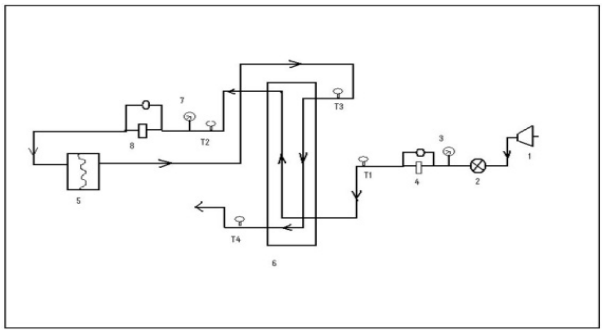
Table 3
Calibration Chart

THERMOMETER(0C)	RTD 1(0C)	RTD 2(0C)	RTD 3(0C)	RTD4 (0C)
30.5	31.85	31.8	31.98	37.04
34	34.87	34.84	35.01	34.03
39	40.31	40.31	40.46	39.48
43.5	44.98	44.98	45.13	44.11
47	48.9	48.89	45.13	44.11
50	51.72	51.69	51.84	50.76
65	66.67	66.71	66.78	65.54
68 85	70.04 86.69	70.06 86.81	70.24 86.87	69.1 85.57
90	91.64	91.79	91.89	90.64
94.5	96.21	96.34	96.45	95.04
100	101.8	101.91	101.99	100.51
105.5	107.55	107.73	107.77	106.38

Different taps on the winding correspond to different voltages, measured from the common end. In a step-down transformer the source is usually connected across the entire winding while the load is connected by a tap across only a portion of the winding. In a step-up transformer, conversely, the load is attached across the full winding while the source is connected to a tap across a portion of the winding.

(h) Test Rig consists of the following components:-

- Compressor
- Control Valve
- 3,7 Pressure taps
- Manometer
- Heater
- Test Section



VI PROCEDURE FOR HOT TESTING

Air is used as the as working fluid in this experiment. The apparatus was connected to a compressor system which is capable of continuously delivering dry air .The compressed air from the compressor enters the laboratory through a control valve which is used to regulate the flow rate through the heat exchanger and then routed to the testing heat exchanger. This is the cold side fluid which is made to enter the heat exchanger from the bottom side and when it comes out it is made to pass through the heater, where it gets heated up and which is then again fed into the heat exchanger from top end and The heat supplied to the heater is controlled with the help two variacs. These pressure taps was connected with tubing and which is connected to a U-tube manometer to give an average reading of the pressure drop. The air inlet and outlet temperatures at both ends of heat exchanger core were measured using four RTD's. The air flow rate was measured using the Rota meter and the mass flow rate of both the fluids can be measured using orifice meter. The pressure drop across the orifice plate can be measured by using U-tube manometers.

VII EXPECTED OUTCOME OF THE PROPOSED WORK

The hot test is conducted to determine the thermal performance parameters of the available plate fin heat exchanger at different mass flow rates and two different hot inlet temperatures of 96 and 66 degree. An average effectiveness of 91% is obtained. It is found in both the cases that the effectiveness and overall thermal conductance increases with increasing mass flow rate It is also found that hot fluid effectiveness increases with flow rate of the fluid and agrees within 4% with the effectiveness value calculated by different correlations and that obtained by using the simulation software, Aspen. Also the pressure drop increases with increasing mass flow rate and experimental values are more as compared to theoretical results because the losses in pipes and manufacturing irregularities have not been taken in to account.

For a particular hot inlet temperature there is an optimum mass flow rate at which the difference between the hot and cold effectiveness of the heat exchanger is minimum and at this point the imbalance is also minimum. We found that the insulation which is provided in the heat exchanger has a significant effect on its performance. It is expected that the imbalance i.e. difference between the hot and cold end temperature can be brought to a minimum level if a perfect insulation like vacuum is provided.

VIII SCOPE FOR FUTURE WORK

Present tests are conducted at room temperatures and in future we can perform the experiment at low temperatures in order to check the performance of the present heat exchanger for Cryogenic applications. In cold testing air at about 100K will be used as the cold fluid. In cold test in place of heater a cold box can be used.

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Software Engineering Research: Understanding SE Paradigms and Methods

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ABSTRACT
There is a broad use of the term "paradigm" in Software Engineering. Concepts such as Structured paradigm, Cascade paradigm or Agent-oriented paradigm are very frequent in SE research proposals. The functional and scientific paradigm in SE is about the functional or engineering paradigm rather than scientific paradigm. Four possible perspectives and, in this context, the scientific perspective is intrinsic and hence very difficult to properly identify and describe. A discussion about the scientific paradigm in SE could help us to evaluate and improve the research practice in SE. A Programming Paradigm is simply a fundamental style of computer programming. It is like the blue print of a construction site. A programming paradigm provides some very basic concepts and patterns which various designers of programming languages adopt and implement.

Keywords: Software, Engineering, Paradigm, Scientific, Functional, Conceptual Framework, Perspective.

I INTRODUCTION

Since inception of software engineering research, one can identify many proposals using the term "paradigm". The meanings of these references are engineering interpretations rather than scientific interpretations. Moreover, there is not an obvious identification of what are the basics and philosophical assumptions in SE research which conform its scientific paradigm. In order to show these concepts, two common interpretations about the general concept of paradigm have been discussed.

The interpretations of the paradigm concept in SE explored. The distinction between software engineering as a profession and software engineering as research discipline has been examined.

Finally, the circle of the previous discussions arguing in favour of the necessary identification and description of the scientific paradigm in software engineering. The main conclusions are summarized.

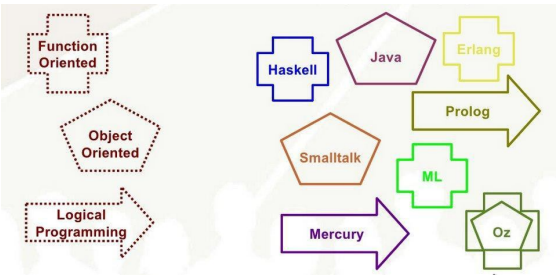

Fig.1 - Some languages, are flexible enough to implement many paradigms in almost native fashion.

II TWO COMMON INTERPRETATIONS

The word paradigm in some dictionaries, find out a definition built on words: "model", "example" or "pattern". For example paradigm is defined as "an example that serves as pattern or model". It is said that a paradigm is a "a model of something which explains it or shows how it can be produced".

These common interpretations appear be included in computer topic, e.g. a paradigm is a pattern which constitutes a process or system model. Moreover, it is said that a paradigm is a technique, method or computer tool, which allows give a solutions to a specific problem.

On the other hand, there is a scientific use of the word. For example it is said that paradigm is "a conceptual framework for a scientific discipline; a set of assumptions, methodologies, and objectives that determine a scientific investigation". Moreover, a "set of fundamental assumptions that influence how people think and how they perceive the world" and also as "a framework of guiding assumptions, theories, and methods that define a particular approach to scientific problems".

Consequently , a understanding of paradigm and, also, a more specific point of view with the scientific understanding of the word "paradigm " that the scientific progress is done through paradigmatic shifts. A paradigm as the total pattern of perceiving associated with a particular image of reality that prevails in a branch of science.

- conceptualizing,
- acting,
- validating, and
- valuing

The cycled model of scientific progress with the first pre paradigmatic stage, where a paradigm has not been yet broadly accepted; a normal science period, where the current paradigm is used; and a revolutionary stage, when the paradigm is changed; this process conform a paradigmatic shift.

Although that science does not precisely follows this pattern, the concept of paradigm imposed, has gained acceptance in discussions.

A scientific paradigm is a radical view, because when a paradigm changes the scientist works in a different world afterwards. There is a moment when different competing paradigms confront each other.

III SUMMARIZING, TWO INTERPRETATIONS OF THE PARADIGM

first, a understanding related to a model, pattern or example of something and, on the other hand, the scientific approach, oriented to a set of assumptions related with a conceptual framework supporting these assumptions and influencing how scientists think and how science is carry out.

The first functional paradigm and the second scientific paradigm. Both interpretations are different because a functional paradigm can be seen as an abstraction tool, something that one can change easily.

Follow a model A under some conditions, and under other conditions one could follow a model B. This does not mean that we have changed our basic assumptions or that we have modified our way of thinking.

On the other hand, Do not change easily the basic assumptions, because assumptions are beliefs. Therefore a scientific paradigm is constituted by a set of beliefs which influence the approach to define the research object and the ways to study it.

Finally, other interpretations for the word "paradigm", especially from grammar, although these interpretations are not interesting.

IV INTERPRETATIONS OF "PARADIGM" IN SE

In Software Engineering the word "paradigm" has been used from many years ago: we have used the cascade paradigm, the structured paradigm, the object-oriented paradigm and some others.

From the modeling point of view the "paradigm refers to a set of related concepts which are used by a person to perceive the real world or a part of it".

The object-orientation as a paradigm means "approach goes beyond the object-based technique…", and that the "… artifacts' of the design process used in conjunction with a modeling based decomposition approach yield a paradigm,…".

The idea of paradigm as a broadly conceptual framework is that software paradigms generally go through three main phases:

(i) early pioneers identify a way of doing things,

(ii) individuals and organisations that are early adopters of leading-edge technologies recognise the potential, and

(iii) basic concepts become more widespread and enter in the mainstream.

The deep analysis includes many relevant points of view from Plato and Aristotle to the contemporaries Foucault and Kuhn. One of the explanations is the metaphor of the darkness glass. The paradigm would be this element that allows us a specific perception of the reality. There are two additional features of paradigms : the existence of the imprecision in the conceptual framework and the idea of a broad application of it.

Moreover the perception that there is some mystic aura around the concept of paradigm. this conception is supported by two elements.

First the darkness glass metaphor, which reflects that an specific paradigm does not allow us to see the reality as is because there is a conceptual framework that acts as a filter and second, it is usual that there is not an agreement about the specific conceptual framework. On the other hand, we could speculate that this last feature allows an extensive use because many interpretations over the same conceptual framework are possible and therefore its use is not limited by the interpretation of this conceptual framework.

A paradigm is constituted by a diffuse conceptual framework can be obtained mixing two results: first, that agent orientation is a software engineering paradigm and second the how the basic social conceptual framework of agent-oriented methodologies have many differences. Thus similar but not identical conceptual frameworks interpreting a specific paradigm (agent orientation).

Coming back to to distinguish between a functional paradigm and a scientific paradigm that, the examples mentioned above refer to how to do software and not how to do science, i.e. the examples show a functional point of view of paradigms.

It is not clear how static is the inherent conceptual framework. i.e., can we easily change our darkness glass? Any answer (positive or negative) guides us to confirm our idea that dividing paradigm between functional and scientific. A positive answer implies that the perception can change easily and therefore we could use different paradigms under different conditions. On the other hand, a negative answer says that the vision is static; the conceptual framework is formed of solid beliefs.

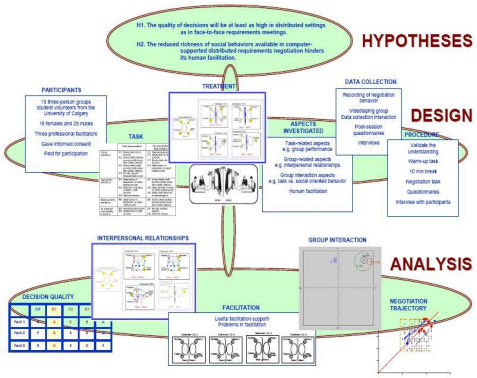

Fig. 2 Literacy view of Design

V THE TWO FACES OF SE: AS A PROFESSION AND AS RESEARCH DISCIPLINE

SE has two faces, the professional face and the scientific one. The concept of SE that "software engineering is an engineering discipline that is concerned with all aspects of software production" and specifies that the basic activities are: software specification, development, validation and evolution. We think that there is no doubt about software engineering being an engineering discipline, in any case some arguments supporting this - that engineering principles have used successfully in order to build complex computer systems. This position is defended as a result of some answers about what is engineering.

The application of scientific knowledge always appears as one of the engineering principles. In this case, mathematics and computer science seems to be the most relevant sources of scientific knowledge provided to software engineering discipline.

However, software engineering is a research discipline too. To rely this belief, where software engineering is assumed a research discipline. In these cases the question is how to do research. In addition, according to the definition of software engineering, we can say that software engineering, as a research discipline, is concerned about the production of software and that the software process is the research object. Therefore, in software engineering as research discipline we have a relevant source of knowledge oriented to improve the software engineering practice. Thus, if the goal of a generic research area is to produce knowledge, then the goal of the software engineering scientific discipline is to produce knowledge about improving the software process.
When one distinguish software engineering as a research discipline that an additional differentiation from related disciplines is necessary. However this specific differentiation could take us some additional space.

Computer science, software engineering and information systems research constitute different research disciplines with different research objects and different research approaches.

In Information Systems (IS) research the term paradigm in the scientific way is clearly acknowledged. For example, a difference between the concept of scientific paradigm and the implications for IS research. Result shows paradigmatic dichotomies in IS research mentioning Positivism.

Those research disciplines are different from Software Engineering in which the research object is the software process. Here there is a clear concentration about conceptual analysis and proof of concepts as its main research approach.

To sum up in favour of differentiating between software engineering as a profession and software engineering as a research discipline. One should distinguish among computer science, information systems and SE research disciplines. This last distinction allows focusing in software engineering as a different research discipline from computer science and information systems.

VI THE FOUR PERSPECTIVES

It is obvious, two types of paradigms and two facets of software engineering. These two differentiations are orthogonal views i.e. that in practical aspects the two types paradigms has been used by both, software engineering researches and software engineers. This cross product provides four different perspectives, (EE) engineering paradigms used by software engineers, (ES) engineering paradigms used by software engineering researchers, (SE) scientific paradigms used by software engineers, and (SS) scientific paradigms used by software engineering researchers. Illustrated these four perspectives in the figure 1. On the EE perspective, that software engineering as a profession uses the different paradigms as tools. Maybe a simple add can be done in a structured way, a calculator could be

implemented with a proper class and a data processing service could be implemented using an agent. But all these alternatives are not really competing.

They are different choices to tackle a software development process. Hence the structured, object-oriented and agent-oriented paradigms coexist without problems and moreover, this coexisting is positive and synergic. These functional paradigms are really engineering paradigms, i.e., model or patterns that guide us the modeling when we need to develop software.

On the ES perspective, engineering paradigms constitute firstly research products and thus a way to focus the current solution approach to software development. Engineering paradigms are not scientific paradigms, because they do not change our assumptions about software engineering is, they do not change our research object (the software process) and they do no change our way to do research. Moreover, the successful of software engineering as research discipline as precisely providing engineering paradigms with their related components (for instance design tools, programming languages, developing techniques and testing methods).

Therefore, the normal and historical behavior of the software engineering research discipline has been to produce engineering paradigms about how to develop software.

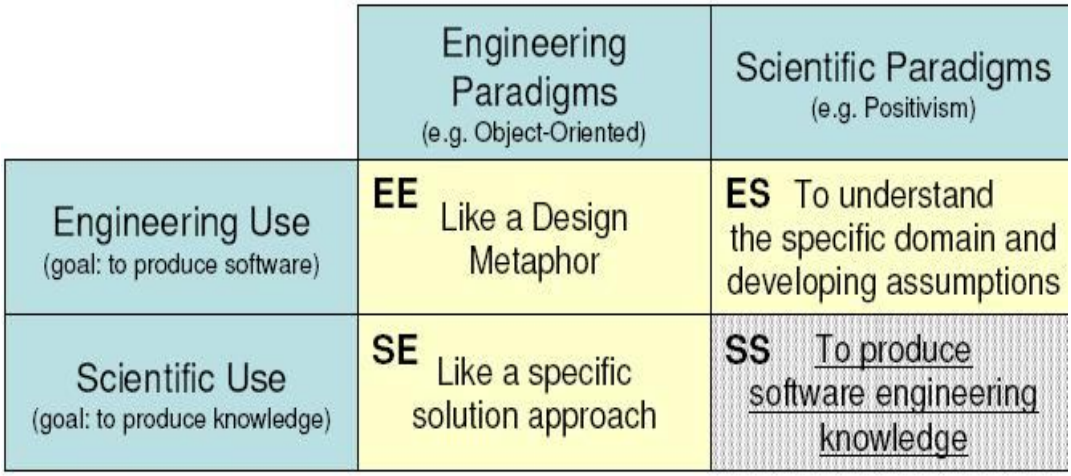

Fig. 3 Perspectives about paradigms in software engineering

On the SE perspective, the use of scientific paradigms and some specific research methodologies into the software process. For example, it is reviewed some scientific paradigms and its application to software development is analyzed.

Where action research and focus groups research methodologies are proposed like requirements elicitation techniques. i.e. scientific paradigms and scientific approaches used into the software process as engineering techniques.

About the SS perspective a debate is necessary. The behavior of the discipline has been static. We have not found a paradigmatic SS discussion in software engineering. In the sense of perhaps we are living a normal science period. But, this period has been critiqued because it has an inherent sense of mediocrity.

This point, should be very debatable, because, there are many proposals about the research methodologies that software engineering could follow. Furthermore, these recommendations oriented to change the research practice and, in this sense, there are initiatives to support a paradigmatic change in software engineering research. However, these proposals are based mainly on importing research methodologies, i.e. using somewhere formulated methodologies in SE.

Thus research methodologies are visualized like technologies. Indeed, we need a broad and critique discussion about what is really the research scientific paradigm in software engineering, the SS perspective. That it is not clear, but, at the same time, its identification and description is the first step to evaluate it, which could allow us seeing our set of inherent assumptions with their weak and strong points. This step is foundational in the generation of a true paradigmatic-shift in software engineering research.

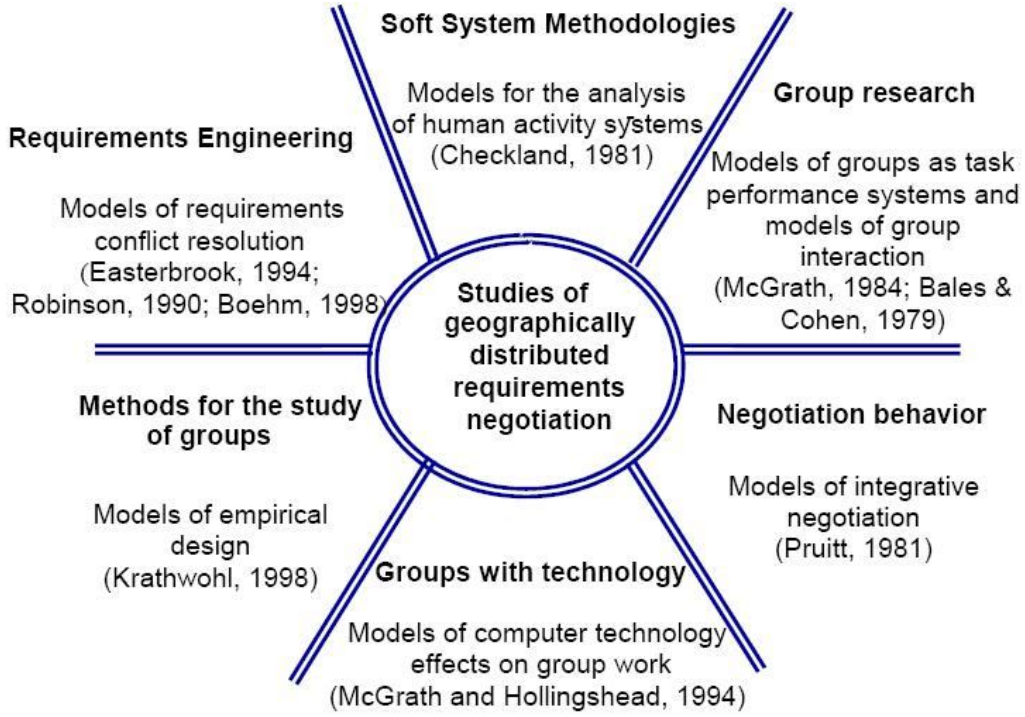

Fig. 4 Research paradigm

VII CONCLUSION

A review of the concept paradigm has been presented there exist at least two types of paradigms: functional paradigms and scientific paradigms. In a parallel way that software engineering has two faces, the professional and the scientific face. We have demonstrated how the traditional concept of paradigm in software engineering corresponds to the functional type, i.e. that paradigm is broadly conceived as a modeling tool rather than a philosophical point of view. Thus we have identified four perspectives to understand the use of paradigms in software engineering.

The scientific perspective of the current SE scientific paradigm is not evident and a broad discussion could be the first step to acknowledge general assumptions which should be the start point of a real paradigmatic shift in SE, which has been the base of memorable research outcomes.

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i. http://sssutms.co.in/web/pageDetails.aspx?subcat=94&cat=NOTICE

ii. https://drive.google.com/file/d/0B784xVGlrtK-cDlMa1hvVVNpckk/edit

A Study and Performance Analysis of Browser based Anti-Phishing Tools; An Experience Report

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ABSTRACT
The anti-phishing tool is said to be ideal, when it is giving accurate, timely result and conspicuously identify phishing websites that user visit. In this paper, popular anti-phishing filter tools are discussed with their functionality. The performance of the anti-phishing tools can varies on the source of URL used for testing method. A browser based anti-phishing system model is proposed to protect the user from phishing attack. In the proposed system, the Add-on tool sends the collected information to the main server which is again categorised in five assigned servers on their functionality. The outcome of the proposed system is showing around 96 percentage successful results after a series of experiments. The proposed system checks and gives the result for all accessed websites.

Keywords **:** Phishing, Anti-Phishing, Add-on, Classification Algorithm, Anti-Phishing Toolbars

I INTRODUCTION

The web browser provides the facility of development and installation of add-on tool in its framework. The user access any web site by using web browser only, so the web browser based system should be developed to aware the user about phishing attack. Some web browsers are already providing the alert system for possible malicious attacks. If the website is not having HTTPs protocol and the user is feeding their credential information on it, the web browser shows the alert message to the user about the possible phishing attack. If the website is suspicious then the web browser checks the security certificate whether it is present in the website or not. After checking the security certificate, the web browser alerts the user about possible problem in the website.

This chapter is based on the anti-phishing tool development, its design and development model. In the proposed anti-phishing tool, the research criteria are based on the URL, content and image matching. All about the add-on development and its working procedure with their screen shots and source code are given for the clear understanding of the anti-phishing tool's working procedure.

II EXISTING ANTI-PHISHING TOOLS

There is a number of anti-phishing approaches proposed earlier to identify a web page as a phishing or not. In this section of study, I have studied the functioning and system details of different earlier proposed anti-phishing tools. Public views and available information related to these tools is collected which is given in the tools downloading web sites. Apart from this, I have observed the basic understanding of how each tool is functioning. The earlier tools are trying to protect the user's confidential information but it is seen that these tools are not completely showing successful results. Mostly tools have defined that legitimated sites are defined as white lists also known as safe sites and the fraudulent sites are defined as blacklists. The proposed method which is used in this research study uses various previously defined concepts. The tool for anti-phishing is developed with the use of publicly available information and the list of phishing and legitimate website details. The description of various anti-phishing tools are described below [1] :

(a) Calling ID Toolbar- CallingID is an anti-phishing tool which focuses on the site ownership details and real-time rating and confirms the user that the site is safe to provide information. This toolbar checks 54 different verification tests for checking the legitimacy of a given site. CallingID directly attacks on the root cause and source of the web usage exposures. The tool uses visual indicators in its toolbar to check the kind of website. These indicators shows different colours for differentiating the web page, just like green colour represent a known-good site; yellow colour represent a site that is "at low risk;"; red colour represent a site that is "at high risk," means most probably be a phishing site. Some of the heuristics used include examining the site's country of origin, length of registration, user reports, popularity of the website and the blacklisted data. The Calling ID Toolbar runs on Microsoft Windows 98 / NT / 2000 / XP with Internet Explorer [2] web browser.
The internet user exposed to fraud and PC damage whenever the user don't know whose site he is visiting. In other words, the user should always know who he is providing information to and

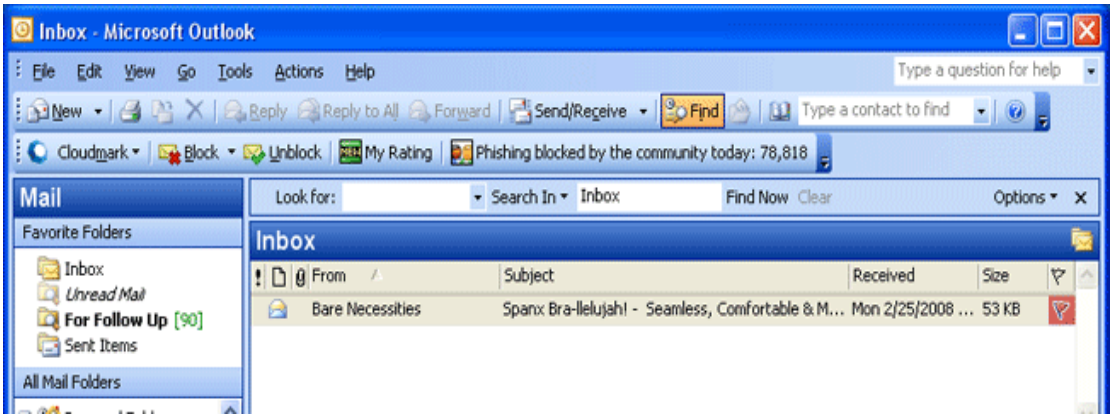
buying from. The snapshot of the Calling ID Anti-Phishing Toolbar is shown below :

Source : http://www.softoxi.com/callingid-video-trailer-screenshots.html

Calling ID is having extensive data sources record and a delivery model enabling us to ensure our safety without bogging down our system [18].

(b) Cloud mark Anti-Fraud Toolbar- The Cloud mark Anti-Fraud toolbar is one other type of anti-phishing toolbar which is based on the users rating [8]. In this toolbar, the user has a right to report the site that is should be accessible or not. On the basis of this feature, the toolbar display a coloured icon on the web browser for each site visited by the user. The green colour icon indicate that the site has been rated as 'legitimate', red colour icons indicate that the site has been determined to be 'fraudulent', and yellow colour icons indicate that not enough information is known to make a determination. Additionally, the user themselves are able to rated site according to their record of correctly identifying phishing sites. Each site's rating is computed by aggregating all ratings given for that site. Each user's rating of a site weighted according to that user's reputation. In the toolbar, no other heuristics are used in determining a site's rating. The functioning of the toolbar is that the sites determined to be fraudulent are blocked and users are redirected to an information page which gives the option of overriding the block.

The Cloud mark Anti-Fraud Toolbar runs on Microsoft Windows 98 / NT / 2000 / XP operating systems with Internet Explorer web browser. In this study, it is noticed that the Cloud mark is no longer supporting the web browser toolbar. The snapshot of the Cloud mark anti-phishing toolbar is shown below :



Source : http://cloudmark-anti-fraud-toolbar-for-microso.software.informer.com/

(c) EarthLink Toolbar- The EarthLink Toolbar approach is based on two combinations of heuristics, user ratings and manual verification [3]. It shows very little information on the EarthLink website. The toolbar display the suspected phishing sites information to the user. These sites after analysis are then verified and added to a blacklist. The toolbar also focuses on the domain registration

information such as the owner, age and country. The toolbar displays a thumb that changes the colour and position. A green thumb up represents a verified legitimate site whereas a grey thumbs up represent that the site is not suspicious, but it has not been verified. The red thumbs down means that a site has been verified to be fraudulent, whereas the yellow thumbs down means that the site is "doubtful." The tool blocks the sites if it is found to be fraudulent. In this case users are redirected to an information page and given the option of overriding the block.

The EarthLink Toolbar runs on Internet Explorer as well as Firefox [3]. The snapshot of the EarthLink is shown below :

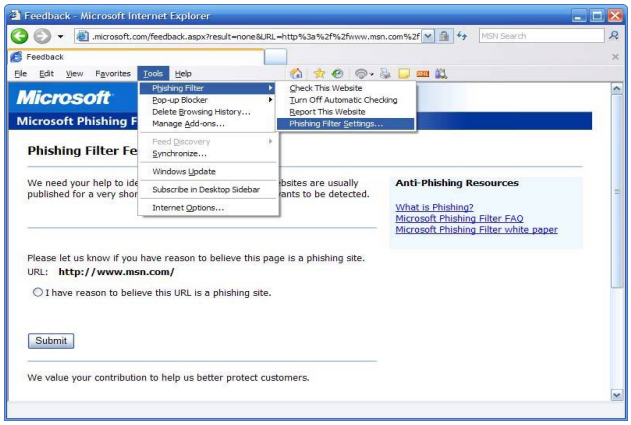
Source : http://www.mccd.edu/myhelp/pop-ups/earth/image001.jpg

(d) eBay Toolbar- The eBay Toolbar is also an anti-phishing tool that uses a combination of heuristics and blacklists [4]. It uses Account Guard indicator that is having three modes: green, red, and grey. If the user operated the eBay (or PayPal) website, the icon is displayed with a green background. The red coloured icon is displayed as a background when the site is a declared phishing site. The icon is displayed with a grey background when the site is not operated by eBay and which is not known to be a phishing site. The information related to known phishing sites blocked and a pop-up appears on the screen which gives the option to the user to override the block. The toolbar also gives users to be able to report phishing sites, which can be verified before being blacklisted. The eBay Toolbar runs under Microsoft Windows 98 / ME / NT / 2000 / XP with Internet Explorer web browser. The snapshot of the ebay toolbar is shown below :

Source : http://download.chip.eu/en/eBay-Toolbar_110514.html

(e) Firefox Toolbar- Firefox toolbar contains a feature that is designed to identify fraudulent web sites. For the Google Safe Browsing Toolbar, system tool is designed which is an optional extension for Firefox. URLs are checked against a blacklist, which Firefox downloads periodically [5]. The toolbar feature displays a popup if it is suspected that the visited site to be fraudulent and present the message to the user to choice leaving the site or ignoring the warning. Optionally, the feature sends each URL to Google to determine the likelihood of it being a scam. According to the Google toolbar downloading site, the toolbar combines "advanced algorithms with reports about misleading pages from a number of sources [6]." The Firefox runs on Microsoft Windows, Apple Mac OS X, and Linux operating systems. The Google Safe Browsing Toolbar on which this functionality is based runs on Microsoft Internet Explorer under Windows XP/2000 SP3+, or Firefox on most platforms.

(f) Microsoft Phishing Filter in Windows Internet Explorer 7- The Microsoft Internet Explorer 7 web browser uses anti-phishing which is based on phishing filter [7]. The tool is basically relies on a blacklist hosted by Microsoft. Apart from this, the tool uses some heuristics when it encounters a site that is not on the blacklist category. If the visiting site is found suspected phishing, website is encountered the user is redirected to a built in warning message and ask the user whether he would like to continue visiting the site or not. Users also have the facility to choose the option to report suspected phishing sites or to report that a site has incorrectly been added to the blacklist. The snapshot of the Microsoft Internet Explorer 7 web browser Anti-Phishing Toolbar is shown below :

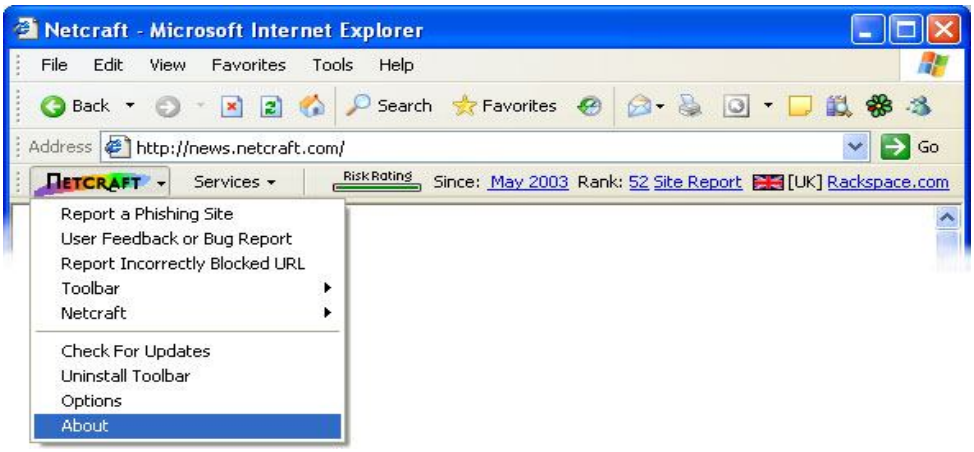


Source: http://winsupersite.com/product-review/internet-explorer-7-beta-1-review

(g) Net craft Anti-Phishing Toolbar - The Net craft Anti-Phishing Toolbar uses several methods to determine the website is legitimate or not [8]. Its website explains that the toolbar (a) clearly depicts sites' hosting location including country which can help you to evaluate spoofing URLs (b) it enforce the display of browser navigation controls (i.e. tool & address bar) in its windows, to defend against popup windows and (c) traps suspicious URLs which contains characters that have no common purpose except to deceive.

The Net craft toolbar also uses a blacklisting, which contains the record of fraudulent sites identified by Net craft and also the sites submitted by users and verified by the company. When a user hit the blacklisted website, a pop-up warning recommends that the access be cancelled, but also provides an override option. The toolbar also displays a 'risk rating' option among the user as well as the hosting location of the site. Users can also use the toolbar to see the more detailed report on a web site.

The Net craft Anti-Phishing Toolbar runs on Firefox mostly and on Microsoft Internet Explorer for Windows 2000/XP operating system. The snapshot of Net craft Anti-Phishing Toolbar is as shown below:

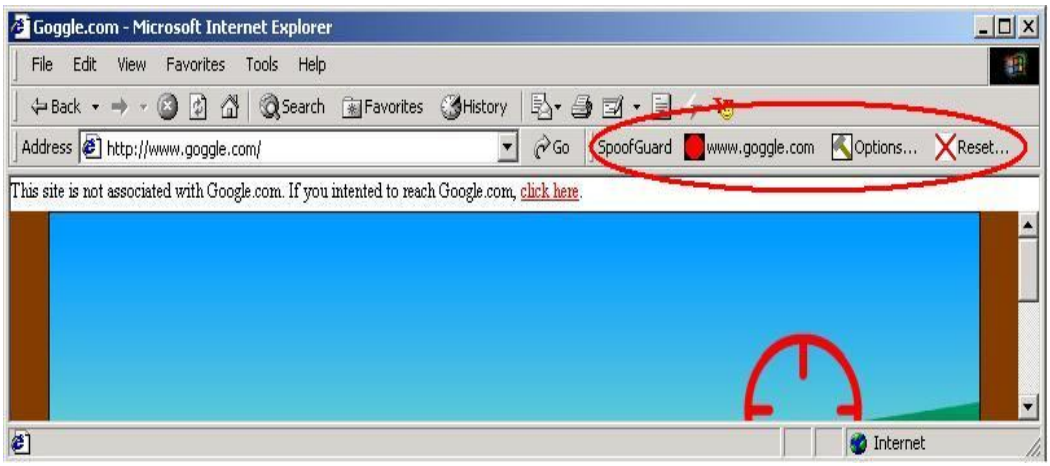


Source : http://www.static.flickr.com/42/123062502_98f75c4f9e.jpg?v=0

(h) Netscape Browser 8.1 - The Netscape Navigator 8.1 web browser uses built-in phishing filter [8,9]. For the testing of the tool as well as the third party reviews, the functionality is the based on blacklisting, which is maintained by AOL and updated frequently [10]. A warning message is appeared on the screen when a suspected phishing site is encountered. The users are shown the original URL and are asked whether or not they would like to precede the website. The Netscape Browser runs under Microsoft Windows, Linux, and Mac OS X. The snapshot of the Netscape Anti-Phishing Toolbar is shown below :

Source: http://www.yevol.com/en/windows/images/browser2.gif

(i) Spoof Guard- Spoof Guard is a tool to which help user to prevent a form of malicious attack called "web spoofing" or "phishing". The phishing attacks generally use deceptive e-mail that looks like a mail coming from a popular commercial site. Generally, the fraudulent e-mail asks the user about account problem or shows some other reason to visit the commercial site and visit the site. The link in the e-mail direct the user to a malicious website that try to collect the user's secret information like account names, passwords and credit card numbers etc. Once the user's information is collected by the spoofing site, the phishing attack may log into the account or cause other serious problems with the account. The snapshot of the Spoof Guard is shown below :



Source: http://crypto.stanford.edu/SpoofGuard/2.jpg

Spoof Guard is a browser plug which is compatible with the Microsoft Internet Explorer. Spoof Guard uses traffic light like symbols in the browser toolbar that turns the colour from green to yellow to red as you access the spoofing site. If the user provides secret information into a form of spoof site, Spoof Guard save the user's data and warn user about the website type. Spoof Guard warn the user it its web browser screen when the alarm indicator reach a level that depends on parameters that are set by the user [11].

The Spoof Guard Toolbar contains three buttons. The first button is Settings Button which brings up the Settings dialog. The second button is Status Button, which display the current domain and a brief representation of the status by using colours. The Status Button brings up a status message when pressed. The third button is Reset Button which removes all the collected data, but do not clear the user's Internet Explorer History.

III DRAWBACK OF BROWSER BASED ANTI-PHISHING SYSTEMS

On the basis of the previous study, some of the drawbacks found in the anti-phishing tool which are needed to solve in further study [12-15]. The earlier proposed and implemented technologies have several limitations, which are as follows:

(a) The proposed blacklist-based technique shows low false alarm rate, but this technique cannot find the websites that are not in the blacklisted database. Because of short life cycle of the phishing websites blacklisted websites are needed to be maintaining systematically.

(b) The heuristic-based anti-phishing system is a higher probability of failed and false alarm method. It is easy for the phishing attack to use technical ideas to avoid the heuristic characteristics detection.

(c) The multi-functioning of the phishing indicators are time-consuming that are not feasible. Also, there is less accuracy rate shows the system for text, images and similarity measurement. Practically, image similarity identification technique is not perfect enough yet for the detection analysis.

(d) The anti-phishing systems take much time to find the type of website.

IV METHODOLOGY

Since the spoofing website remains almost similar to the legitimate website so that the internet user doesn't find at that moment, which website he is accessing. The spoofed website matches almost 90 to 99% of the legitimate website [16-19].

In the study of phishing website detection, a system model is prepared which is based on the phishing criteria [21]. Since when the web user access the website and fill the confidential information into it, the user must be informed instantly about the type of the website. To find the accurate result and instant response, the accessed dataset is categorised at different assigned servers, these are

(a) Group 1 : Character based

- Number of dots ' . ' present in the URL
- Number of dots '@' present in the URL
- Number of dots ' // ' present in the URL
- Existence of IP address in the URL
- Port Number in the URL

(b) Group 2 : Coding based

- Title Tag
- Form Tags on the web page
- Image Tags on the web page
- href Tags on the web page

(c) Group 3 : Identity based

- Country Code present in the URL
- Login/Password evaluation
- Script Tags on the web page
- Link Tags on the web page

(d) Group 4 : Contents based

- The websites which are having HTTPs protocol
- Number of Phishing Keywords present in the URL

(e) Group 5 : Attribute based

- Finding Domain Age
- First Webpage Creation Date
- Snap of Web matching
- Taking declared phishing websites from other authorities

The reason of categorising the system in different groups is to find the spoofed website as quickly as possible when the web user hit the target URL. In the system design, one main server takes care of the functioning of the add-on and sends the received information to five assigned servers. The assigned servers are defined in five different categories; these are *Character based, Coding based, Identity based, Contents based and Attribute based.* All the above mentioned groups are defined on different servers with its database information. When the internet user hit the target, instantly the concerned information about the webpage goes to these servers. On the assigned server, the information is cross checked with the database information. If it is found that the some portion of the webpage information matches with the database information, the server reply to the user system about the matching status.

On the basis of achieved information, Add-on displays a warning message on the web browser screen about the type of website which user is accessing. If user wants to continue accessing the website and feed the confidential information in it, the user can skip this warning message and can continue accessing the website. If the system has tested the user access website is phishing website, the user will be warned again 'Not to access the website'. If user want to discontinue the accessing the website, the website will be blocked for further access. Since the user has already submitted the confidential information like password into the spoofed website, so the user advised to change the password instantly.

The Figure 1 shows the error rate of different anti-phishing tools by collecting the dataset in different days. The proposed system tool is showing less error rate in all the days. The error rate can be calculated by 'No. of phishing websites/No. of legitimate websites [20]. The reason of showing less error rate is that the main server is collecting the data from one of the assigned servers only. This process takes less time to analyse the data and produce accurate result.

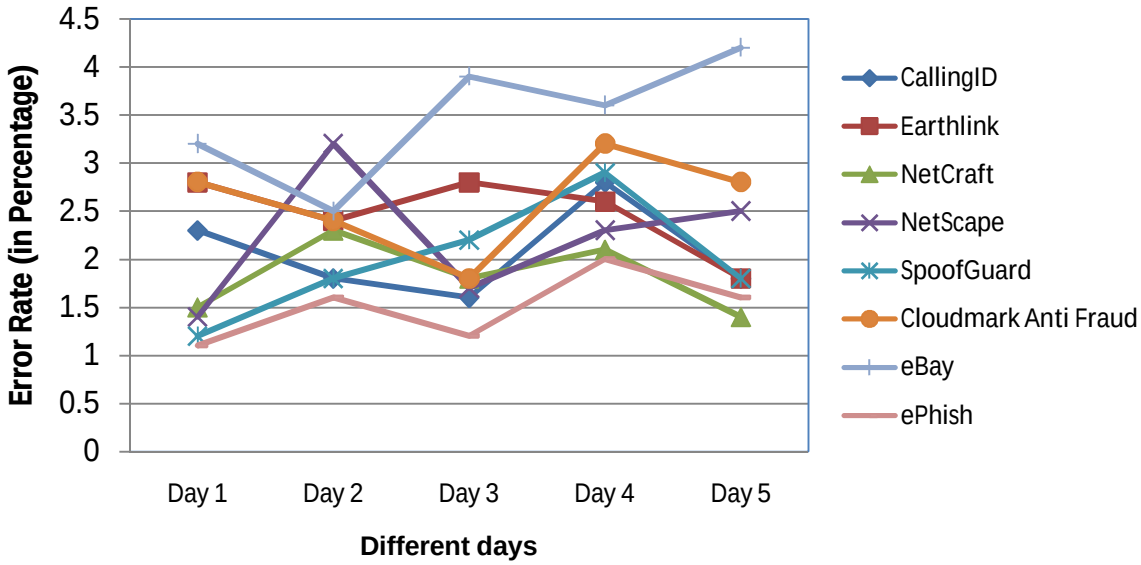


Fig. 1 Error Rate Analysis of Different Anti-Phishing Tools when hitting the websites in different days

V CONCLUSION

In the phishing attack, the user sends their confidential information on mimic websites, so the user should be informed immediately about the type of website. For this, a browser based add-on is prepared and studied with the already declared phishing and legitimate website data sets. To make awareness among of the user about phishing or legitimate website, the web browser should provide the security tools for the user. In the proposed add-on, the system is divided in five different assigned servers and the performance of the system is tested in the form of error rate analysis. The performance evaluation of the proposed anti-phishing add-on is compared with the existing anti-phishing tools and found that if the task is divided into different system, it can give better results. The proposed anti-phishing tool is compared with the anti-phishing tools like Calling ID, EarthLink, Net Craft, Netscape, Spoof Guard, Cloud Mark and ebay.

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A Critical Study of Employability of Pass out of Professional Institutes in Madhya Pradesh

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ABSTRACT
The current research attempts to analyze and compare the employability of the undergraduates and recent pass out engineering students across Madhya Pradesh with reference to the specific & generic skill level required in industry. The analysis is based on sample response from regional, national, global employers and engineering graduates' respondents drawn from Bhopal, Jabalpur & Vidisha region of Madhya Pradesh. The data was collected through a questionnaire survey in which thirteen attributes of general skills and fourteen attributes of specific skills were measured; using five point scale based on their importance levels. The study intends to analyze and measure the levels of employability and the variation there in as per gender, type of institute (Government or private), medium of schooling & city, and the expected employability level of the employers. The sample from students studying in final year & recent pass out group reveals that the employability of engineering graduates of M.P. is lower than the score required in industry. This low level of employability is seen on account of both generic skills & specific skills. This indicates that despite of increase in numbers of engineering colleges & efforts to increase the employability, the engineering graduate lacks in employability skills. The findings suggests that engineering institutes, should focus to improve the skill set of graduates, focus on the assessments and curricula in analyzing and solving engineering problems, as well as increased creativity and interact more with Industries to understand the particular demand for skills in that region and sector. It can be further enriched with the involvement of Industry in academics. After classifying all skills by factor analysis, it is found that the soft skills are very important specifically the communication skill. The analysis also confirms that the male and female respondent does not differ significantly on account of employability. Tools used for analysis are reliability test, factor analysis, cronbach's alpha test, mean score, standard deviation, t-test analysis, ANOVA and other statistical tools. The result of analysis reveals the low level of employability skills among the engineering undergraduates & pass-outs of M.P.

Keywords: Employability of Engineering graduates, employment, expectations of Industries, enhancing the employability, sustainable employability, Employability skills

I INTRODUCTION

The study is focused on the important issue i.e. "Employability of Engineering graduates", with a special emphasis on the undergraduates and fresher graduates from Technical Institutes of Madhya Pradesh. Two other questions which this study addresses are why it is important to address the issue of Employability, and how this might be achieved as per the expectations of Industries. The study also focuses on the best practices adopted worldwide to enhance the Employability & recommendations on how to adopt such practices in the various Institutes of Madhya Pradesh.

The World bank & other national surveys made on employability are of global & national perspective, which I think needs to be based on region wise as the undergraduates of Madhya Pradesh have different environment of learning like city, language, facilities at Institutes, family background, level of schooling etc. It has been seen from last few years that the Engineering graduates of Madhya Pradesh are facing difficulty in getting employment. There are several reasons of unemployment, but the fact is that the expectations of Industries are not met, there are job demand but our graduates are unemployed. My objective of this study is to bring awareness among stake holders about the issue of employability, so that the students, Institutes & policy makers can take corrective measures for enhancing the employability by providing the proper environment for nurturing the excellence among undergraduates.

This study was made by making the survey of students of Engineering Institutes of Bhopal, Jabalpur & Vidisha Districts of Madhya Pradesh. Approximately one lakh students acquire admissions every year in Engineering colleges, but since last three years the admission rate is reducing. This is also a matter of great concern. Professional and vocational Institutes runs various courses like ITI, Diploma, MBA, MCA, PGDCA, BE, Mtech, B.Pharma, M.Pharma etc & various other specific professional & vocational courses like Hotel Management, fashion designing etc. Earlier it was thought to consider all or most of such undergraduates for the survey, but looking into the reality and feasibility of task it was decided to make the study of engineering undergraduates whose employability is of major concern. The reason of choosing engineering undergraduates is the numbers, which are very high i.e. large

students; take admissions in Engineering Institutes, more numbers of Engineering Institutes & decrease in Employability of Engineering Graduates.

This study focuses at exploring the contemporary skills set required for sustainable employability of engineering graduates in Madhya Pradesh. In most of the engineering colleges, students are from different academic backgrounds coming from different native places having different mother tongue. So, there is an urgent need to provide them a common platform to make them competent enough to face the real challenges of today's corporate world. Madhya Pradesh being the Hindi speaking region and major population lives in rural part, the communication skill and specially the English is of major concern. English is a language which can be used as a tool to remove the lingual difference among them and give them a common platform to communicate. According to my findings, the students with skills like positive attitude, effective communication, problem solving, time management, team spirit, self-confidence, handling criticism, flexibility, which are also known as soft skills as a whole, have much better chances of survival in the tough corporate world compared to the students who are lacking in the mentioned soft skills. Employability skills are very essential in the current global job market. These skills can be termed as soft skills, which are given utmost importance in campus interview. At college level education, it will be a productive venture to incorporate these skills in the syllabus. This will certainly help students develop their employability portfolio and it will make them execute the assigned works efficiently in any institution after the selection process. This study tries to list the skills needed for the students to get employed and show how these skills are important for them to excel in a performance oriented work environment.

II OBJECTIVES & HYPOTHESIS

The aim of the research is to analyse and compare the skill need of Industry and the available skill level in engineering students across MP. The study will also examine, highlight and provide overview of possible options for students, institute, industry and government in relation to take appropriate measures to fill this skill gap. The study will also create awareness among Institutions for updating their resources for improvement in the standard of education.

(a) The main points for framing the objectives-

(i) To Identify issues / gaps between the need of Industries for technical / vocational skill set & the availability of manpower resources in the current system of technical education.

(ii) To understand the challenges being faced by the stakeholders of the system and lessons learnt for delivering favourable outcomes at various levels within the loop of the system.

(iii) To study the initiatives, current approaches and best practices being adopted worldwide in the current scenario, and suggest the best possible practices to be adopted in the current system.

(iv) To take an initiative to develop self interest in industries and corporate world by assuming responsibilities for fulfilling their need for educated skilled manpower.

(v) To suggest the possible options and workable measures to be adopted for Human Resources skill development in the current scenario.

(vi) To provide insight into how different stake-holders & policy makers can best support and work to improve the employability of engineering undergraduate.

(vii) Explore the issue of engineering graduate employability

(viii) To compare the employability skills.

(ix) Provide an overview of skills required for reducing the employability gaps.

(b) Specific objectives- The above objectives are further narrowed & made specific for the study purpose. Now reframed, narrowed & specific objectives are :

(i) To analyze and compare the skill requirement of Industry and the available skill level in the undergraduate & graduates engineering students across Madhya Pradesh

(ii) To identify the difference in the level of employability skill among private institutes and government institutes engineering students

(iii) To identify the difference in the level of engineering students employability skill among the genders

(iv) To identify the difference in the level of engineering students employability skill among the students coming from Hindi and English medium schools.

(v) To identify the difference in the level of engineering students employability skill based on the selected demographics

(c) Sub objectives- The following are secondary objectives of the study:

(i) To give suggestive measures/ possible solution to the institutions and other stake holders to bridge the employability skill gap.

(ii) Identify examples of best practices in regard to reforming engineering education to enhance the employability.

(d) Hypothesis- On the basis of observation and the available literature following Hypothesis has been taken in the present research:

(i) There is no significant difference in the Employability level of Private & Government college engineering graduates.
(ii) There is no significant difference in the Employability level of Female & Male engineering graduates.
(iii) There is no significant difference in the Employability level of engineering graduates coming from Hindi or English medium school
(iv) There is no significant difference in the Employability level of engineering graduates of Bhopal, Vidisha and Jabalpur districts of Madhya Pradesh.
(v) There is no significant difference in the existing Employability level and the expected (by Industries) Employability level of engineering graduates of M.P.

III RESEARCH METHODOLOGY

(a) Research Method- This research was conducted using a survey research method. The target and accessible populations were engineering graduates of Institutes of M.P. and employers.

The participants are evaluated under two main skill sets, which are very much important to justify themselves with their professions. These skills are classified in to two parts first is Generic skills, second is Specific skills, and these skills has various sub-skills.

(b) Population- The data has been collected from the questionnaire distributed among 500 undergraduates and graduates of different engineering institutes of Bhopal, Vidisha & Jabalpur city of Madhya Pradesh. Out of the total population 324 students have furnished the complete information.

The undergraduates were in the sixth, seventh, eights semester and fresher graduates

Questionnaires were distributed to 90 employers and 40 had responded.

(c) Research Instruments- I have used a modified questionnaire "Employability Survey Questionnaire" which is based on employer satisfaction survey conducted by FICCI and World Bank survey from September to November, 2009.

The questionnaire has a list of skills 13 Generic skills & 14 Specific skills that engineering graduates are typically expected to possess at graduation.

Respondents were requested to rate on a scale from 1 (below average) to 5 (excellent) how they rates on this employability skill.

The "Employability Survey Questionnaire" comprised 27 items for assessing students' employability skills. The participants responded to each of the statements using five-point Likert scales.

(d) Data Analysis- Data is entered in SPSS & analyzed using the descriptive and inferential statistics. Descriptive analysis involves frequencies, percentages, mean and standard deviation whereas inferential analysis involves t-Test. ANOVA, percentage are used to explain the demographic items of students whereas mean and standard deviation are used to analyze level of employability skill of students. The t-test is conducted to identify the differences between employability skills with the demographic variables, type of institutes, gender & medium level education background.

Hypothesis raised were tested using t- test & ANOVA.

IV DATA ANALYSIS

The Statistical Packages for Social Sciences (SPSS) version 21.0 was used in analyzing the data. For Reliability analysis of Scale we used ALPHA Reliability Coefficients. The descriptive statistics to be used include mean and standard deviation. The inferential statistics used was the respondent's t- test of independent samples for testing equality of means and Analysis of Variance (ANOVA). , is used for testing differences within and between several group means. Few of the variable from the results of quantitative analysis are considered for qualitative assessment and analysis.

The data collected from the questionnaire survey were summarized and the SPSS outputs were interpreted.

Table 1

Attributes of Skills under Study

	Science & Engineering skills
1.	Ability to Identify, Formulate & solve Technical problems
2.	Ability to Design a System or Process to meet desired needs
3.	Technical Skills
4.	Basic Computer
5.	Advanced Computer
6.	Ability to Design and Conduct Experiments, as well as to Analyze & Interpret data
7.	Ability to use Appropriate and Modern tools, Equipment, and Technologies
8.	Ability to apply Knowledge of Mathematics, Science & Engineering
9.	Creativity
	Communication skills
10.	Communication in English
11.	Written Communication
12.	Verbal Communication
13.	Reading
	Enterprising skills
14.	Decision making
15.	Integrity
16.	Entrepreneurship Skills
17.	Customer Service Skills
	Intellectual skills
18.	Reliability
19.	Knowledge of Contemporary issues
20.	Teamwork
21.	Self-Motivated
	Socialite & Cognitive skills
22.	Empathy
23.	Accepts Responsibility for consequences of actions
24.	Flexibility
	Learning skills
25.	Willingness to Learn
26.	Understands & takes Directions for Work Assignments
27.	Self Discpline

Fig 1. Mean of Employability

(a) Gap in available level & expected level of employability skills- The above table shows the mean of employability level of engineering graduates by their self assessment, assessment by employers and expected level by employer. Survey is done to find the expected skill set and its employability level. The result of survey and analysis reveals that on and average industry expect the employability level of 4.12, and the existing employability level is 3.12. The comparison reveals the gap in available level & expected level of employability skills. The engineering graduates of Madhya Pradesh are lagging in employability level

V RESULTS AND DISCUSSIONS

The statistics reveal that the existing employability level of engineering graduates and expected employability level by industry was obtained significant. The mean value has been observed higher for expectation by industries compared to existing employability level of engineering graduates assessed by employer and hence the Hypothesis is rejected.

(a) The attributes contributing to the low employability are:

(i) Engineering graduates are less adaptable to change
(ii) They are less creative in identifying innovative approaches to solving problems
(iii) They are less empathetic to others feeling
(iv) They are less dependable in carrying out a defined task
(v) They have less confidence in decision making
(vi) They are Lagging in ability to handle & operate modern tools, equipment, and technologies, specific to the job which they intend taking up

(vii) They are very average in ability to Identify, Formulate & solve Technical problems & breakdowns. And have difficulty in providing appropriate solutions

(viii) They are less capable in Designing a System or Process to meet desired needs.

(ix) They are not at par to Design and Conduct Experiments, as well as to Analyze & Interpret data.

(x) There competency is low in Advanced Computing and working on database;

(xi) Not having in depth and up to date domain knowledge of their branch of study

(xii) They are not so perfect in Written Communication;

(xiii) They are lagging in Verbal Communication, especially in English.

(xiv) They are not so perfect at reading & comprehending the technical drawings or written communication of clients

(xv) They are lagging in Entrepreneurship skill

(xvi) Less or no exposure to industries, less institute industry interaction. They have less exposure to authentic-practical working atmosphere.

(b) Expected skill set and its employability level

Modern workplace need flexible and responsible employees, who go beyond narrow task requirements and who approach work proactively. The tables mean of employability shows the mean of employability level of engineering graduates by their self assessment, assessment by employer and expected employability level by employer. The result of survey made reveals that on and average industry expect the employability level of 4.12, and the employability level of engineering graduates of M.P. is 3.12. The comparison reveals the gap in available level & expected level of employability skills. The engineering graduates of Madhya Pradesh are lagging in employability level.

Table 2
Summary of Hypothesis

#	Hypothesis	Stat Results	Significance	Remark
H1	There is no significant difference in the Employability level of Private & Government college engineering graduates.	P > 0.05	No Significant Difference	Hypothesis Accepted
H2	There is significant difference in the Employability level of Female & Male engineering graduates.	P < 0.05	Significant Difference	Hypothesis Rejected
H3	There is significant difference in the Employability level of engineering graduates who had done schooling from Hindi or English medium.	P < 0.05	Significant Difference	Hypothesis Rejected
H4	There is significant difference in the Employability level of engineering graduates of Bhopal, Vidisha and Jabalpur Districts of Madhya Pradesh.	P < 0.01	Significant Difference	Hypothesis Rejected
H5	There is significant difference in the existing Employability level and the expected (by Employers) Employability level of engineering graduates of M.P.	P < 0.05	Significant Difference	Hypothesis Rejected

VI FINDINGS

The study was set out to access the employability level of engineering graduates of Madhya Pradesh, the study has identified and measured the attributes contributing to the employability skills. The study has also sought to know the difference in the level of employability skills among engineering graduates with respect to gender, private / government institutes, city of institute, medium of schooling and the difference in employability level of engineering graduates accessed by self and accessed by Employers. The study sought to answer the following questions:

(a) What is the level of employability skills of engineering graduates of Madhya Pradesh?

(b) Does medium of schooling has any impact on employability skill?

(c) Does gender has any impact on employability skill?

(d) Is there any difference in employability skill of engineering graduates of private and government institutes?

Based on conclusions the set of recommendations are made with overview of possible options for students, institute, industry and government in relation to taking appropriate measures to fill this skill gap. In addition to this, suggestions for future research are highlighted and the limitation of research study is mentioned followed by the overall conclusion of the entire research project.

The sample from engineering graduates of Bhopal, Jabalpur & Vidisha districts reveals that the employability level is lower than the requirement of industry. This lower level of employability is seen on account of both technical and soft skills. This indicates that despite of huge job requirements from industries, high percentages of graduate engineers from Madhya Pradesh are unemployed.

With reference to the objectives, hypothesis and data analysis the conclusion is that the employability level of engineering graduates from Madhya Pradesh is low.

VII RECOMMENDATIONS

Engineering graduate's employability is a major concern of all stake holders of technical education system. Based on the finding of the study, the following recommendations are made for the betterment of the system and ultimately address the employability problem by enhancing the level of employability skills.

(a) Both Government and private institutes & university need to focus on the improvement of machine, equipments & infrastructure, redesign of curricula, upgradation of teaching-learning methods and employing well qualified & experienced teachers.

(b) There is need to establish stronger links between :

(i) institutes and industries,
(ii) Knowledge, skills and attitude,
(iii) education and skills,
(iv) theory and practice,
(v) supply and demand.

Appropriately structured mechanisms are needed at all levels to impart skills which will make India's demography more employable. Different set of recommendations are made according to the stake holders and beneficiaries, their roles and initiatives to bridge the skill gap of engineering graduates

(c) Recommended Model- A model is recommended to the Institutes for enhancing the employability. Basically it is a 11 step model, which emphasis on the things in control of institutes.

(d) The model recommends various steps, which include modification in the existing system, establishment of new system, M&E, redefine learning system, reforms inputs, bench mark global standard and use of web based system for effectiveness in the system.

(e) SASC (Self Assessment Score Card) & SMQAS (Self Monitoring Quality Assurance System) quality improvement system is recommended based on best practices adopted worldwide.

CONCLUSION

The present study clearly reveals that the employability level of engineering graduates of M.P. is lower than the requirement of global industry. This low level of employability is seen on account of both technical and soft skills. This also indicates that despite of huge job requirements from industries, high percentages of graduate engineers from Madhya Pradesh are unemployed. Finally it may be concluded that the employability level of engineering graduates from Madhya Pradesh is low to get placement in the industries.

The study has identified attributes contributing to low employability among selected groups i.e; both Government and private institutes need to focus on improvement of their resources. There is significant difference in the employability level of male and female engineering graduates. The students who had done schooling from Hindi medium need to focus more on communication skill. Engineering graduates need to improve on their employability skill i.e; they should be multi skilled to gain and sustain employment.

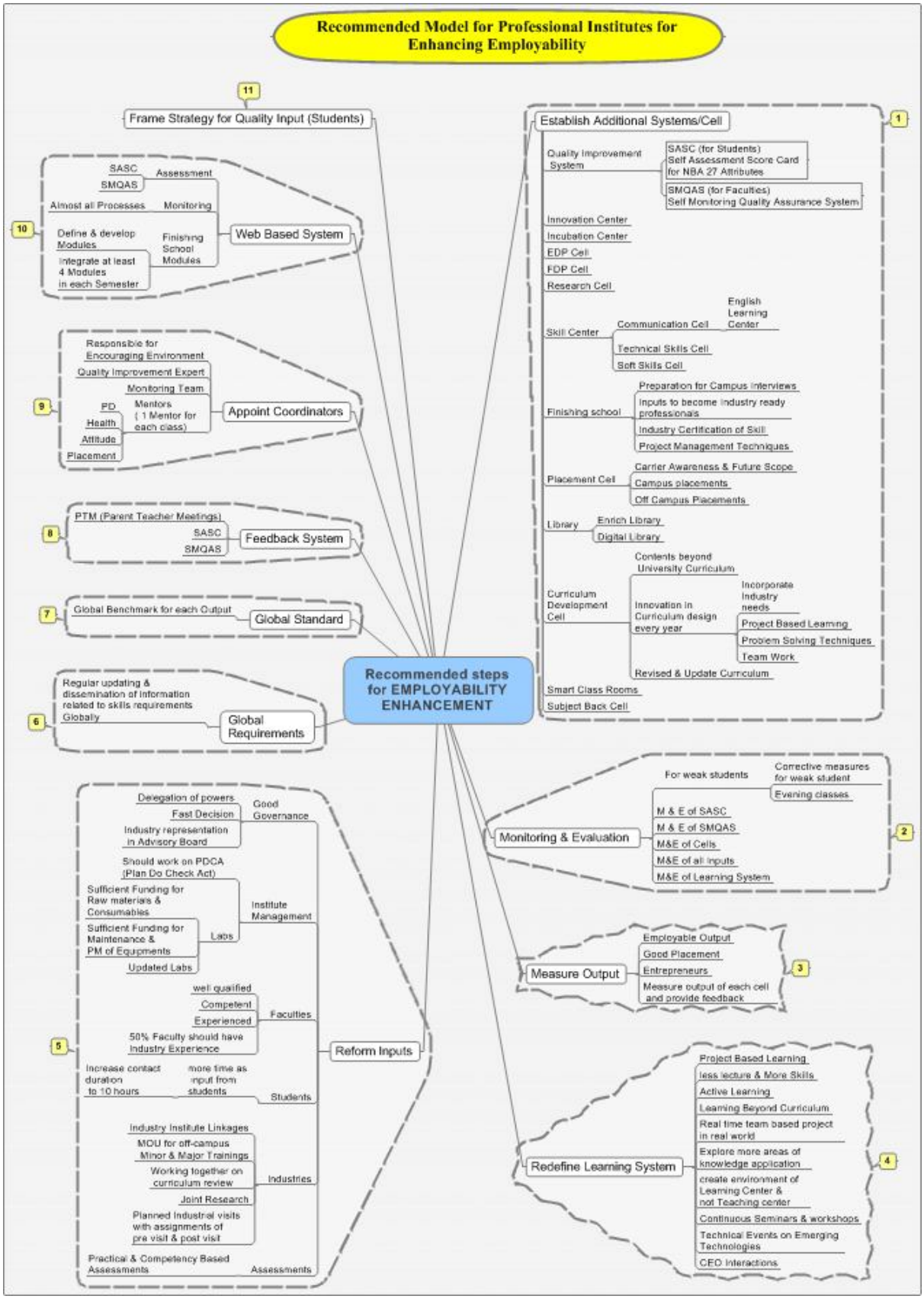

Fig 2 : Recommended model

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Green Computing to Reduce Hazardous Impact of E-Waste

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I INTRODUCTION

"Of late, green transformation is often being talked about very vehemently. What better a way to achieve this transformation than by embracing the 'intelligent buildings' philosophy?"

Green Computing is the practice of using computing resources efficiently in order to reduce e-waste and the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote recyclability or biodegradability of defunct products and factory waste.

II DEFINITION

Green Computing is a discipline that studies, develops and promotes techniques for improving energy efficiency and reducing waste in the full life cycle of computing equipment from initial manufacture, through delivery, use, maintenance, recycling and disposal in an economically realistic way. The term Green Computing also describes Green IT that refers to the study and practice of designing, manufacturing, and using computer hardware, software, and communication systems efficiently and effectively with no or minimal impact on the environment. 'Green'‖ has become a popular term for describing things that are good for the environment, generally healthful and, more recently, economically sensible. Going Green‖ implies reducing your energy use and pollution footprint. The technology community, specifically computer users, has popularized the term ―Green Computing, that helps in the reduction of the pollution and energy footprint of computers.

In this regard, **Energy Star Program** was started by U. S. Environmental Protection Agency (EPA)

The following hazardous elements and compounds can be found in everyday e-waste:

(a) Lead in cathode ray tubes and solder
(b) Mercury in switches and housing
(c) Arsenic in older cathode ray tubes
(d) Antimony trioxide as flame retardant
(e) Polybrominated flame retardants in plastic casings, cables, and circuit boards
(f) Selenium in circuit boards as power to supply rectifier
(g) Cadmium in circuit boards and semiconductors
(h) Chromium in steel as corrosion protection

in 1992. Green computing is also known as green information technology (green IT). One of the sequels of green computing after Energy Star Program was **EPEAT or Electronic Products Environmental Assessment Tool**. EPEAT products serve to increase the efficiency and life of computing products.

'Necessity is mother of all inventions'; the need for Green Computing came from fact that the whole globe is **now** full of e-waste.

Electronic waste, e-waste, e-scrap, or waste electrical and electronic equipment ('WEEE) describes discarded electrical or electronic devices. There is a lack of consensus as to whether the term should apply to resale, reuse, and refurbishing industries, or only to product that cannot be used for its intended purpose.

E-waste contains more than 1000 different substances, many of which are toxic metals such as lead, arsenic, cadmium, hexavalent chromium and flame retardants used in the plastics. The fraction including iron, copper, aluminum, gold and other metals in e-waste is over 60%, while plastics account for about 30% and the hazardous pollutants comprise only about 2.70%.

(i) Cobalt in steel for structural strength and magnetivity

III INDIA'S CURRENT E-WASTE SCENARIO

Due to the rapid developmental activities, country like India, today, face a fast increasing load of WEEE originating from both inland and through illegal imports. E-waste is one of the fastest growing waste streams in the world due to increasing "market penetration" in developing

countries and “replacement market” in developed countries.

In India, the electronic waste management assumes greater significance not only due to the generation of our own waste but also dumping of e-waste particularly computer waste from developed countries and the amount of e-Waste generated is steadily increasing. At present Bangalore alone generates about 8000 tonnes of computer waste annually and in the absence of proper disposal, they find their way to scrap dealers. E-Parisaraa, an eco-friendly recycling unit on the outskirts of Bangalore makes full use of e-Waste. The plant which is India’s first scientific e-waste recycling unit reduce pollution, landfill waste and recover valuable metals, plastics & glass from waste in an eco-friendly manner. But, this type of initiative is required more from all the parts of India. The Director of E-Parisaraa, Mr. P. Parthasarathy, developed an eco-friendly methodology for reusing, recycling and recovery of metals, glass & plastics with non-incineration methods. The hazardous materials are segregated separately and send for secure land fill for ex.: phosphor coating, LED’s, mercury etc.

IV MAGNITUDE OF PROBLEM AND ENVIRONMENTAL AND HEALTH HAZARDS OF E-WASTE

A study on the effects of E-waste on human health reveals serious negative outcomes for those dismantling and handling components of discarded electronics. The study, published by the Royal Institute of Technology in Stockholm, Sweden, details that workers, some as young as six years of age, are routinely exposed to hazardous materials and inhalation of toxic gases through direct handling of discarded electronics. People affected by this health crisis are mostly in areas where there is little knowledge about the health risks and in many cases no basic health care or social protections.

Table 1
The environmental impact of the processing of different electronic waste components

E-Waste Component	Process Used	Potential Environmental Hazard
Cathode ray tubes (used in TVs, computer monitors, ATM, video cameras, and more)	Breaking and removal of yoke, then dumping	Lead, barium and other heavy metals leaching into the ground water and release of toxic phosphor
Printed circuit board (image behind table - a thin plate on which chips and other electronic components are placed)	De-soldering and removal of computer chips; open burning and acid baths to remove final metals after chips are removed.	Air emissions as well as discharge into rivers of glass dust, tin, lead, brominated dioxin, beryllium cadmium, and mercury
Chips and other gold plated components	Chemical stripping using nitric and hydrochloric acid and burning of chips	Hydrocarbons, heavy metals, brominated substances discharged directly into rivers acidifying fish and flora. Tin and lead contamination of surface and groundwater. Air emissions of brominated dioxins, heavy metals and hydrocarbons
Plastics from printers, keyboards, monitors, etc.	Shredding and low temp melting to be reused	Emissions of brominated dioxins, heavy metals and hydrocarbons
Computer wires	Open burning and stripping to remove copper	Hydrocarbon ashes released into air, water and soil.

V RECYCLING OPERATIONS FOR CURRENT DISPOSAL

To handle problems caused by e-waste, environmental scientists emphasis on 3R (reduce, recycle and reuse) process as an alternative to the present e-waste management practice. For a developing society like India, reduced use of electronics equipments is not a feasible option; therefore, more emphasis is on reuse and recycling processes. Segregation of toxic substances at the root level with systematic planning can eliminate the pollution load and develop a green society. Used or unwanted electronic equipment should be discarded in a convenient and environmentally responsible manner. Computers have toxin metals and pollutants that can emit harmful emissions into the environment. Computers should never be discarded in a landfill. Computers should be recycled through manufacturer programs such as HP's Planet Partners recycling service or recycling facilities in the community. Still-working

computers may be donated to non-profit agencies. The recycling methods adopted in India include open burning of circuit boards or using acid stripes which are potentially harmful. The IP chips are reused. The parts that cannot be used are sent for open dumping to extract metals like copper. PVC-coated cables are openly burnt. Nitric acid is also used to remove Gold and Platinum. Both open burning and acid baths lead to occupational exposure to pollutants and endanger the health of nearby communities. This has been linked with various health problems like Silicosis, Respiratory irritation and pulmonary oedema.

VI METHODOLOGY USED

For this piece of work, Secondary sources of data like recent newspaper and journals, articles, authentic internet resources, etc were evaluated for the purpose of this study. Through such resources, attempt has been made to find E-waste in Indian context, which in turn helped in identifying the wide range of diverse stakeholders in the green computing. Secondary sources of data were preferred in order to accommodate the current scenario and research related to E-waste in India which are highly dispersed and diversified.

VII GREEN COMPUTING FOR CURRENT DISPOSAL

"There is no gain saying the fact that strategy minus execution or execution devoid of strategy can be counterproductive. In pursuing green goals, enterprises are enswathed with issues of good strategy-bad execution or bad strategy-good execution. This should be avoided at all costs". For the same, that is., Krishna, Balasubramanian and Mudireddy proposed an algorithm using virtualization techniques to reduce e-waste and that fulfill green computing.

The Algorithm goes like:
When more than one process is waiting for server, then server consolidation decides which process should be assigned to server services. Here, server consolidation refers to a set of rules and regulation that find out the efficient way to which process will be processed in server process. The algorithm proposed here inherits some properties of process management, which tries to minimize the server's process time.

To reduce the waiting time and to utilize the processor, the three researchers gave a new algorithm. The basic idea is to make quantum time dynamic for each process queue. For that the process should be divided in to the different queues. The number of queues should be decided at the run time. To divide the processes in the queues, the limit should be calculated first. The formulae to calculate limits are as follows:

Limit1= (H.B.T. – L.B.T.+1)/N
Limit2= (L.B.T. + Limit1)
Limit3= (L.B.T. + Limit2), where, H.B.T. = Highest burst time of the process, L.B.T. = Lowest burst time of the processes and N= No. of queue(determined at run time)

Like this the limit will be determined for each queue and according to the limit processes will be filled in the queues. Once the queue has been made, the quantum period will be decided for each process queue separately. To calculate the quantum period for each process queue the formulae is:

$$T_{(b)} = \frac{\left(\sum B(i)\right)}{N}$$

Where, B(i)= Total of processes in ith queue and N= No. of processes in ith queue
Once the quantum time has been calculated for each queue the dynamic variation of quantum period will be implemented to reduce the waiting time. The formulae to determine the dynamic variation of quantum period is:
if (Tb - Bi) < (Bi / 2) then
Tdi = Tb + (Tb - Bi)

Where, Tb = Quantum time of any process in queue
Bi= Allotted quantum period to that queue
Tdi= time quantum allotted to the ith process
Using this formula each process is allotted a dynamic quantum time and gets executed according to that.

VIII RECOMMENDATIONS FOR ACTION AND REDUCTION OF E-WASTE

Current trend of "***replace-rather-than-repair***" mentality is polluting the planet with electronic waste. Green Computing is towards efficient utilization of resources. Energy is considered as the main resource, therefore, the emphasis is to reduce the energy utilization and increase the performance of Computing. There are several areas where researchers are putting lots of efforts to achieve desired results. Following are the major methods and technologies which helps in green IT:-

(a) E-Waste Recycling- Over 133,000 PCs are discarded by U.S. homes and businesses every day and less than 10 percent of all electronics are currently recycled, this is based on the study by US Researchers. Majority of countries around the world require electronic companies to finance and manage recycling programs for their products especially under-developed Countries. Green Computing must take the product life cycle into consideration; from production to operation to recycling. E-Waste is a manageable piece of the waste stream and recycling e-Waste is easy to adopt. Recycling computing equipment such as lead and mercury enables to replace equipment that otherwise would have been manufactured. The reuse of such equipments allows saving energy and reducing impact on environment, which can be due to electronic wastes.

(b) Telework and Telepresence- Telework and Telepresence, two of the least understood elements in Green IT, are rapidly being included in the public and private sectors as a means of reducing e-waste and saving energy. Teleworking has been actively used by the private sector companies like IBM, Microsoft, Sun Microsystems, Bank of America, Procter and Gamble, and Cisco for decades. It is claimed that considerable amounts of energy is saved and e-waste avoided with employees working at their homes. As fewer hardware resources like PCs, printers, copiers and various other equipments have to be installed at the work premises, the e-waste is reduced. Though it is difficult to measure the effects of Telework, the benefits of Telepresence can be more easily estimated as the cost of travelling is reduced. With more and more companies using these elements the effective reduction in e-waste will be quite substantial. Perhaps the least understood element in Green IT measurements is the contribution of Telework to energy savings. A recent UK study found that the typical teleworker generates a third more CO_2 over a year than an office worker. Telework is generally regarded as both a productivity enhancer and a differentiator in recruiting employees, although the private sector has been more actively using it than the public sector. Companies like IBM, Microsoft, Sun Microsystems, Bank of America, Procter and Gamble, and Cisco have been teleworking for decades and have also claimed significant additional savings in real estate; that is, releasing buildings and offices because the work is being done at home or client site. Nearly half of IBM‟s workforce of over 300000 teleworks. While teleworks‟ benefits are not easy to document, the business case for telepresence, the use of technology to hold meetings and other work sessions normally requiring travel is easier.

(c) Cloud Computing- Scaling is one of the key concepts in cloud computing. It provides scaling of design, scale of use, and even reverse scaling of cost per unit. The common technology provides an average of 140 servers per administrator, but with scaling many cloud providers can now provide as many as 1000 or more servers per administrator. It is evident that scaling can reduce a huge amount of e-waste with server to administrator ratios improving by up to sevenfold. Many companies today are migrating towards cloud computing for data storage and resource virtualization. This also helps in reducing e-waste drastically as many companies depend on the existing cloud service provider's servers and data centers instead of installing its own servers. Cloud computing is both a metaphor and an indicator of the significance of Green IT. Every time an organization shifts a workload of storage or processing to the cloud they are reducing their overall electricity usage, since the massive new data centers used for cloud services are all striving, like the Yahoo and Capgemini facilities mentioned above, to reduce power usage drastically. Major reductions in cost are achieved in the cloud, too.

(d) Virtualization- Virtualization is a set of techniques that leads to efficient server management through higher utilization and reduction in energy expenses. Through the use of intelligent virtual machine allocation, improved data center automation and resource reclamation of underutilized CPUs, virtualization can reduce e-waste. In the past, individual servers, sometimes thousands of them in one data center, were using only 5 to 15% capacity, waiting for work, so to speak. But over a million servers had been virtualized by 2008 and, by one estimate, the combination of virtualization of servers and storage plus improving air flow could alone reduce data center operating costs by half.

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Public Perceptions about Atomic Energy and Radiation

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ABSTRACT
Since the discovery of ionising radiation (1895) and radioactivity (1896), atomic energy has practically established itself firmly all over the world. Its applications can be found in practically all parts of the globe andtouches almost every aspect of human life. Today, it is helping the mankind in meeting the challenges of the everincreasing demand for energy, food and water and is assisting them in their industrial growth, mitigation of global warming, healthcare and environmental issues.Although atomic energy and radiation technologies havecontributed immensely to the growth and betterment of human life all across the world, they are always shrouded by undue fears and perceptions which do not have a scientific basis.

I A HISTORICAL PERSPECTIVE

A historical perspective of perceptions about atomic energy makes an interesting observation. Immediately after discovery of radiation (x-rays) and radioactivity, there were high hopes from them. They were believed to possess magical healing and health, stamina and sex boosting powers. All these beliefs were not based on scientific finding, clinical research or trials. The acceptance was based entirely on benefits (risks were not known) as perceived by the people and as advertised by the manufacturers. It was only in 1930s that horrifying results of blatant consumption of radioactive substances and over-exposureto radiation started coming to light. Although the craze for these magical radioactive potions died in the thirties, radio quackery is still going on at least in some parts of the world.

The discovery of fission in 1939 by Fermi followed by rapid development of nuclear weapons finally culminating in dropping of nuclear bombs on Hiroshima and Nagasaki in 1945. Theconsequences are deep rooted fear psychosis in the minds of common public which persists even today.

With the declaration of 'Atoms for Peace'programme by Eisenhower in 1953 and subsequent establishment of IAEA and of course marathon efforts by radiation technologists for developing a variety of applications of radiation for societal development, slowly but steadily established atomic energy with a wider perspective. Today, these applications have become so much accepted by the society that the total business in these applications all over the world far exceeds the business of electricity generation by nuclear power. This definitely was helping in acceptance of the nuclear power by society although the ghosts of Hiroshima and Nagasaki continued to maintain a scare about this technology. The very frequent open-air and underground nuclear weapon tests by many countries were greatly contributing to the negative image of nuclear power. Against this backdrop, the mid sixties, seventies and eighties saw deployment of large number of nuclear power plants particularly in USA, Canada and Europe. After the first major accident in a nuclear power station at Three Miles Island, there was a setback particularly in USA although it kept flourishing in Europe with champion efforts of France. When thingswere appearing alright, Chernobyl happened in 1986 and had a prolonged adverseeffect on the global growth of nuclear power.

During the first decade of 21st Century, nuclear power appeared to be making a come-back and was being considered as an important technology for mitigation of global warming. In 2007 the inter-governmental panel on climate change (IPCC) in its 4thassessment report stated that "Nuclear (Power) has the largest and lowest cost GHG reduction potential in power generation". Once again when things were looking highly favourable for large expansion of nuclear power sector (even Germany had deferred its earlier decision to close all its NPPs), Fukushima happened and opened up fresh arguments against nuclear power.After more than three years of Fukushima disaster, once again nuclear power is trying to come back with many countries having launched new nuclear construction post Fukushima, of course India being the first one to do so.

During all these years a steady growth in the deployment of radiation technologies for societal benefits kept the flag of nuclear power flying. This happened in three ways – firstly rapid deployment in OECD countries, marathon efforts by IAEA in deployment of these technologies in many developing and under developed countries and may be slow but steady deployment in some developing countries like India through their self-reliant efforts.

II PUBLIC PERCEPTIONS AND REALITIES

Although there might be hundreds of questions often asked by the society about nuclear power, they can be grouped into six main perceptions. These perceptions and the corresponding realities are as follows.

(a) Nuclear power spreads nuclear weapons. This perception is mainly based on the horrific memories and stories associated with Hiroshima and Nagasaki. Often we do not realise the fact that nuclear electricity industry was in no way responsible for Hiroshima and Nagasaki. The reality is that in 1945 when atomic bombs were used against humanity, this industry (nuclear electricity generation) did not exist. First nuclear power reactor came into existence in 1954 at Obninsk in the then USSR. Thus, if we think logically, we come to the conclusion that nuclear power reactors are neither compulsory nor necessary for making nuclear weapons. The problem of nuclear armament is not due to nuclear industry but due to our thinking and approach towards world peace. If the entire mankind takes a resolution not to make nuclear weapons, nuclear power can in fact play an important role in nuclear disarmament by diverting the fissile material used for making weapons, for electricity generation.

The second perception is associated with safety of nuclear power. People often perceive nuclear power as inherently unsafe. This perception has a direct association with the Three Mile Island (1979), Chernobyl (1986) and Fukushima (2011) nuclear accidents. A logical analysis of these accidents and their impact is necessary. The global nuclear industry has an operational experience of 15000 reactor years during which only 3 major accidents have taken place. In the Three Mile Island accident, the reactor was badly damaged but there was no release of radiation or radioactivity. This accident therefore had no impact whatsoever on the health of people or on the environment.In the Chernobyl accident, the reactor was totally destroyed and 237 people suffered acute radiation sickness (ARS) of which 31 died within 3 months of the accident. Most of them belonged to the fire fighting and rescue teams. No further deaths have been identified due to ARS. An UNSCEAR report places the total confirmed deaths from radiation at 64 as of 2008. In Fukushima, four reactors of old vintage were written off due to the accident. Not a single life was lost and there were no harmful effects from radiation on local people.

If we compare the number of accidents and fatalities in the accidents in various electricity generation technologies, the real information comes out. The Paul Scherrer Institute (PSI) of Switzerland who maintain the data base of such accidents, in one of their reports of 2011 have summarized severe accidents with at least 5 immediate causalities during 1970-2008. Nuclear technology stands out as the safest compared to all other technologies including coal, oil natural gas, hydro, bio-fuel and wind.

(b) The third perception is that nuclear electricity is comparatively costlier. The reality is that the nuclear electricity tariffs are quite competitive. During 2013-14, the average unit energy cost of nuclear electricity from Indian nuclear power plants was Rs. 2.71 per kWh.In the oldest nuclear power station TAPS 1&2 it was merely Rs. 0.97 per kWh and in the latest power reactor – Kundankulam -1 it is Rs. 3.94 per Kwh. These costs are quite competitive with hydro and thermal power and quite cheaper than most of the renewable resources.

(c) The fourth perception is that while many 'wise' countries have either given up or have decided to give up nuclear power, why India is going crazy after it ?Specially after declaration by Germany after the Fukushima accident that they will close down all there nuclear power reactors for ever by 2022, there is lot of debate about it in India. Here we must understand one thing that our geographical status, the status of the neighbouring countries, political situation, economic condition,electricity demand and supply status, energy resources status and population (present and projected) status are totally different from Germany. Actually, we should look at the world status of nuclear power. Presently, there are totally 443 nuclear power reactors in 30 countries of the world with a total installed capacity of 381.2 GWe. 66 nuclear reactors are under construction in 15 countries. As per IAEA, there are 30 countries who propose to build nuclear reactors for the first time. As per Alexander Cychkov, Deputy Director General, IAEA, the global nuclear generation capacity is expected to register an increase of 23-100 % by 2030. Maximum growth is expected in Asia. It is interesting to note here that 23 reactors are currently under construction in China alone.

(d) The fifth perception is about nuclear waste. Generally people think that radioactive waste is a problem without solution. Reality is that nuclear waste is the pride of nuclear industry because firstly its relative volume is very low and secondly technology for its management and isolating it from public domain for a long time has already been developed and is being practiced. India, because of its 3 stage nuclear power programme

has been following closed nuclear fuel cycle right from the inception of its programme. The spent fuel from Indian reactors is reprocessed and most of the material (99.9%) is recovered and rescued. The high level waste (HLW) contains more than 99.9% of radioactivity from the reactor (fission products and actinides). This waste is vitrified and immobilized. The vitrified waste is then sealed in double walled SS Canisters which are further sealed in radiation tight lead casks and are stored in a specially engineered underground Solid Storage and Surveillance Facility (SSSF) for 40-50 years. India is amongst a few countries who have mastered this technology. Finally after 40-50 years of storage in SSSF, these canisters are proposed to be stored permanently in specially engineered geological repositories at a depth of more than 1 km – isolated from normal life, ground water or any biological activity. Point to be noted here is that the entire process costs a mere 2 paise per unit which is included in the tariff.

(e) The sixth perception is that nuclear energy is not favourable to environment. People often tend to believe that some amount of radioactivity and radiation keeps leaking from a nuclear reactor and has an adverse effect on the neighbourhood population, flora and fauna. Reality is that nuclear reactors are so designed, constructed and operated that the radiation released from them is a very small fraction of the natural background radiation. During the 15000 reactor years of global and 400 reactor years of Indian operational experience of nuclear power reactors, the radiation does isfar less than the permitted levels. During many epidemiological surveys in the neighbourhood areas, not a single incidence of increased occurrence of cancer or genetic defects in new born children has been detected. In fact, we can very proudly say that the environment around nuclear power stations is much better and greener than some public areas of the country. There is abundant greenery around all reactors and various animals, birds and butterflies are found abundantly there.

III CONCLUSION

Public acceptance is the biggest challenge for the required growth of nuclear power. Eradication of irrational perceptions prevalent in the society is therefore absolutely essential. Dr. Anil Kakodkar, Former Chairman, Atomic Energy Commission often used to say- “The job of the public outreach personnel is as important as that of the person designing a reactor.” In fact with an ambitiously expanding nuclear power programme, gaining public confidence assumes even greater importance. We very urgently need to change the public perception so that rather than asking ‘Why nuclear? the public must start asking, ‘Why not nuclear?’

The exploration of new phosphors by Mineral Inspired Methodology using American Mineral Society Database

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ABSTRACT
White LEDs are labelled as solid state semiconductor lighting, which will act as future generation lighting to replace conventional lamp and backlight due to the advantages of low power consumption, free of mercury, high response, no thermal radiation, long life time, high stability and so on. Currently available phosphor in the market mainly they are high correlated colour temperature, low Colour Rendering Index, synthesis process is difficult. Phosphor-converted white light-emitting diodes for indoor illumination need to be warm white (i.e., correlated colour temperature, 4000 K) with good colour rendition (i.e., colour rendering index 80). For the synthesis of new phosphor, the concept, as well as the methodology of using a mineral-inspired approach in combination with solution parallel synthesis (SPS) for exploration of new phosphors among Na/K, Sr (Ba)/Sc-silicate along with the artificial library, is reported. Moreover, the compositional tuning of the properties of extended solids through solid solution; sometimes referred to as the game of x and y, as, for example, in $K_{1-x}Na_xSr_{1-y}Ba_yScSi_2O_7$ *is also demonstrated. Our expected out come to develop new phosphor using mineral inspired methodology for develop high luminous efficiency and CRI of the phosphor.*

Keywords: - Phosphor, SPS method, chemical compound, etc.

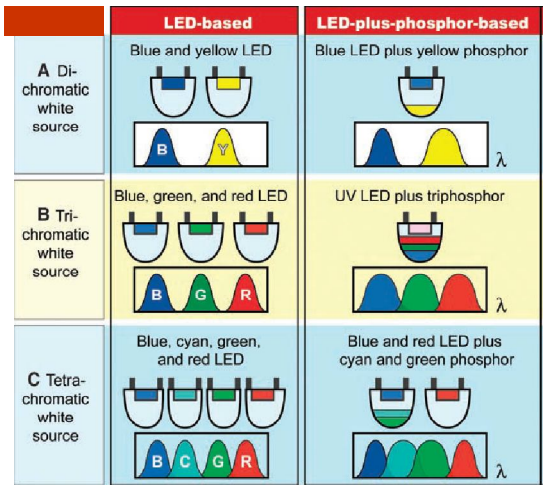
I INTRODUCTION

Phosphor-When a substance absorbs energy in some form or other, a fraction of the absorbed energy may be reemitted in the form of electromagnetic radiation in the visible or near visible region of the spectrum. This phenomenon is called luminescence. [Latin word 'lumen' means light]. The word 'luminescence' was first used by Eilhardt Wiedemann, a German Physicist in 1988. If the excitation is achieved by the bombardment with photons the corresponding process is called Photoluminescence (PL). The solid materials exhibiting luminescence property are referred to as phosphors. The phosphor materials are used in white LEDs. [1-4] White LEDs are labelled as solid state semiconductor lighting, which will act as future generation lighting to replace conventional lamp and backlight due to the advantages of low power consumption, free of mercury, high response, no thermal radiation, long life time, high stability and so on. Therefore, the white LEDs are promising candidates to replace conventional incandescent and fluorescent lamps in the coming future. The advanced countries in the world, such as United States, Japan, and European Union, Korea and so on, all invest a lot of resources in the research and development of white LEDs. [5] Most "white LEDs" in the production today use a 450 nm - 470 nm blue GaN (gallium nitride) LED covered by a yellowish phosphor coating usually made of cerium doped yttrium aluminium garnet (YAG:Ce) crystals which have been powered and bound in a type of viscous adhesive. The LED chips emit blue light, part of which is converted to yellow by the YAG:Ce. In Science yellow light stimulates the red and green receptors of the eye, the resulting mix of blue and yellow light gives the appearance of white. Typically, white light can be generated by the combination of blue LED chips and a yellow phosphor, YAG: Ce^{3+}. However, the disadvantages of this method are a colour-rendering index (CRI) and high correlated colour temperature (CCT) due to red emission deficiency in the visible spectrum. During the past few years, white LEDs fabricated using near ultraviolet (n-UV) LEDs (380-420 nm) coupled with red, green and blue phosphors have attracted much attention due to advantages of colour stability and excellent colour rendering. Thus, the development of new phosphors with high quantum efficiencies for the UV LED application is highly desirable [6-11]. In the US alone, for example, fluorescent lights consume around 200 terawatts-hours of electricity annually. If these lights were all replaced with 200 lm/W TLEDs, the US would use around 100 terawatts-hours less energy (equivalent to 50 medium sized power plants) saving more than US$12 billion and also preventing around 60 million metric tons of CO_2 from being released into the atmosphere. So LED is the energy saving as well as the environmental friendly.

II METHOD USED IN WHITE LEDS

White light could be generated by several methods, such as two-wavelength white light method use blue LED + yellow phosphor, yellow ZnSe substrate + blue CdZnSe. This type of white light formation LED not produce by other because blackness of their patent. Another method three

wavelength white light use red, green, and blue, ultraviolet LED + Red, green, and blue phosphors, and another combination blue LED and red and green phosphors. Utilizing the colour-complementary theory, one can use the blue LED to couple with yellow-emitting phosphor or yellow-emitting ZnSe substrate collocated with blue-emitting CdZnSe film. The former concept is claimed in the patents of Nichia and Osram, and the latter one belongs to Sumitomo Electric Industries' right (Japan). The methods of no patent blocked still include several types: one is the combination of red, green, and blue chips, whose cost is so high that it disagrees with high throughput; the others are ultraviolet (UV) LED coupled with red, green, and blue phosphors, or blue LED coupled with red and green phosphors. Therefore, the investigation of UV and blue LED-converting phosphors is the key point of developing white LEDs [7] [12].



III DRAWBACKS

White light emission can be generated by UVLED coupled with red, green, and blue phosphors or blue LED coupled with red and green phosphors. However, it is very difficult to find combinatorial phosphors with the same optimal excitation wavelength and material degradation rate. The transitions of an activator with *f-d* or *d-d* electron configurations are affected by host lattice and for this reason the optimal excitation wavelength of an activator is different with host lattice. Besides, the transitions of an activator with *f-f* electron configurations are hardly affected by host lattice, so the excitation spectrum exhibits sharp peaks and the position of optimal excitation peak shows no obvious changes. For example, the characteristic optimal excitation peak of Tb^{3+} is at 378 nm, and that of Eu^{3+} is at 394 nm. Furthermore, the extreme difference in material stability and degradation between different host phosphors will produce colour aberration. As a result, the excitation-wavelength restriction and colour aberration will be shown in combinatorial phosphors for white LEDs. In addition to the energy savings and positive environmental effects promised by solid-state lighting, solid-state sources in particular, LED-based sources offer what was inconceivable with conventional sources: controllability of their spectral, spatial, temporal, and polarization properties as well as their colour temperature. Technologies currently emerging are expected to enable tremendous benefits in lighting, automobiles, transportation, communication, imaging, agriculture, and medicine.

IV MOTIVATION

The motivation for the developing the new phosphor is its properties such as long operation time, energy saving compact size, save money, lower temperature, environment family, mercury free and so on. Owing to their reduced power use, LEDs in conjugation with renewable energy sources also offer great promise in providing lighting in remote and underdeveloped areas of the world. The luminous efficiency of a light source is a key metric for energy savings considerations. It gives the luminous flux in lumens (light power as perceived by the human eye) per unit of electrical input power. Luminous efficiencies of 425 lm/W and 320 lm/W could potentially be achieved with dichromatic and trichromatic sources, respectively, if solid-state sources with perfect characteristics could be fabricated. Perfect materials and devices would allow us to generate the optical flux of a 60-W incandescent bulb with an electrical input power of 3 W. Besides luminous efficiency, colour rendering is an essential figure of merit for a light source used in illumination.

For the synthesis of new phosphor by "Mineral Inspired Methodology" based on searching natural mineral containing Si from "American Mineral Society Database" is best method. In this method Substitution of one element of a particular composition by similar sized isovalent ion. For example the substitution of transition metal ions by similar sized and isovalent ions (Fe^{2+}, Cu^{2+}) by Mg^{2+} and (Ti^{4+} by Zr^{4+}). The table listed below show the name of mineral with their original composition and change their composition new phosphor is developed.

V OUTCOME

Our expected outcome is much spared we wanted to change the important properties of the phosphor converting white LEDs such as colour rendering index, correlated colour temperature, luminous efficiency, quantum efficiency. Above properties of the already developed phosphor is not sufficient so we want to increase it by exploration of new phosphor by mineral inspired methodology. The large number of phosphors derived from minerals evidences the fact that this that this ‘‘mineral inspired methodology’’ for developing a new phosphor is advantageous and less time-consuming than the combinational method developed by a generic algorithm. Apart from this approach, another fact that the needs to be documented is that, until now, the reported silicate phosphors were mainly synthesis by a conventional high temperature solid state reaction methodology, [13–15] which has some drawbacks such as the volatility and low-melting point of the starting materials and possible side reactions eventually fail to produce the desired compounds.

The large number of phosphors derived from minerals evidences the fact reaction methodology which has some drawbacks such as the volatility and low melting point of the starting material and possible side reactions eventually fail to produce the desired compounds.

VI CONCLUSION

The most recent record is just over 300 l/w, LED which can be compared to 16 bulbs for regular light bulbs and close to 70 for fluorescent lamps. As about one fourth of world electricity consumption is used for lighting purposes, the highly energy-efficient LEDs contribute to saving the Earth’s resources. So exploration of new phosphor for the fabrication of phosphor converted LED (pc-LED) is highly desirable.

Name of Mineral	Original compositions of Minerals	Artificial Composition inspired by Natural Mineral Standard Composition	Solid solutions
Armstrongite	**$CaZrSi_6O_{15}.2.5H_2O$**	**$CaZrSi_6O_{15}$**	**$(Ca,Sr)ZrSi_6O_{15}$**
Benitoite	**$BaZrSi_3O_9$**	**$BaZrSi_3O_9$**	**$(Ba,Sr)ZrSi_3O_9$**
Calciohilairite	**$CaZrSi_3O_9.H_2O$**	**$CaZrSi_3O_9$**	**$(Ca,Sr)ZrSi_3O_9$**
Cataplelite	**$Na_2ZrSi_3O_9.\ 2H_2O$**	**$Na_2ZrSi_3O_9$**	**$(Na,\ Li)_2ZrSi_3O_9$**
Elpidite	**$Na_2ZrSi_6O_{15}.3H_2O$**	**$Na_2ZrSi_6O_{15}$**	**$(Na,K)_2ZrSi_6O_{15}$**
Parakeldyshite	**$Na_2ZrSi_2O_7$**	**$Na_2ZrSi_2O_7$**	**$(Na,K)_2ZrSi_2O_7$**
Terskite	**$Na_4ZrSi_6O_{16}.2H_2O$**	**$Na_4ZrSi_6O_{16}$**	**$(Na,\ Li)_4ZrSi_6O_{16}$**
Aenigmatite	**$Na_2Fe_5TiSi_6O_{20}$**	**$Na_2Mg_5ZrSi_6O_{20}$**	**$(Na,\ Li)_2Mg_5ZrSi_6O_{20}$**
Titanite	**$CaTiSiO_5$**	**$CaZrSiO_5$**	**$(Ca,\ Sr)ZrSiO_5$**
Natisaite	**Na_2TiSiO_5**	**Na_2ZrSiO_5**	**$(Na_2,\ K)ZrSiO_5$**

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