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Importance of Strategic Environmental Assessment (Sea) Process and Environmental Health Impact Assessment (Ehia) Process Towards Sustainable Climate Change And Control

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Abstract. The resource conservation and recovery (RCR) method has been devised prior to environmental health impact assessment (EHIA) process for certain projects such as nuclear power plants (Vijayan Gurumurthy Iyer, 2004) . Strategic environmental assessment (SEA) process can be broadly defined as a study of the impacts of a proposed project, plan, project, policy or legislative action on the environment and sustainability. Vijayan Gurumurthy Iyer (2022) mentioned that the root cause problem solution for ozone layer depletion potential (OLP) impact, global warming potential (GWP) impact and green house synergic (augmentative) gas (GHG) emission impact in context to industrial, source specific and generic plants that are measured, monitored and mitigated by international environmental impact assessment process (Figure-3) for the sustainable environmental climate change and control. In this research, SEA process has been aimed in order to incorporate environmental and sustainability factors in to project planning and decision making process such as project formulation and appraisal of Indo-Matsushita midget electrode (battery carbon rod) plant in 1979 at Tada, and proposed Nawada Nuclear power plants industrial, source specific and generic plants processing that should have included policies, programs, plans and legislative actions. Sustainable development is a kind of development that meets the needs of the present without compromising the ability and efficacy of future generations to meet their own needs. Environmental Impact Assessment (EIA) process can be defined as the systematic study and check of the potential impacts (effects) of proposed projects, plans, programs, policies or legislative actions relative to the physical-chemical, petrol-chemical, biological, cultural, and socioeconomic components of the total environment. The primary purpose of the EIA process is to encourage the consideration of the environment in organizational project planning and decision making process and to arrive at actions that are environmentally compatible. Organization process and product planning should include the integrated consideration of technical or engineering, economic, environmental, safety, and health, social and sustainability factors to achieve business excellence. Prior to the National Environmental Policy Act (NEPA) process in 1970 in the USA, technical and economic factors dominance the World's projects. The objective of the study is to conceptualize SEA process for the climate change and pollution control. The design of the study is cross sectional. Environmental Health Impact Assessment (EHIA) process has been conducted for nuclear power plant to consider the environmental health quality, safety and health impacts to mitigate psychological health effects on workers and nearby residents. Social Impact Assessment (SIA) process can be defined as the systematic

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identification and evaluation of the potential social impacts (effects) of proposed projects, plans, programs, or legislative actions such that social consideration is encouraged in process and to arrive at actions that are socially compatible with reference to a proposed nuclear power project at Rajouli, Nawada District, Magadh District . Nawada is in southern Bihar and is well known for its natural beauty. Water fall and forest ecosystem makes Nawada is a sustainable town in Southern Bihar.

SEA process concerns to environment and sustainability effects in process and arrive at proposed projects, plans, programs, and legislative actions that are compatible with respect to environment and sustainability issues. International EIA process required multi-disciplinary approach that has been conducted very early stage of Japanese Matsushita carbon rod project in 1982 at Tada, Sullurpeta District for strategic environmental assessment. The paper highlights SEA process conducted for certain projects that based on operation and process approach and associated studies for sustainable development. Product environmental life cycle analysis (LCA) has been conducted for identifying and measuring the impact of petrochemical and corroded engineering structural products on the environment and sustain efficacy by means of mass and energy balance methods in M/S Madras Fertilizers Limited, Manali, Chennai, India. LCA considers the activities related to raw materials, transformation, ancillary materials, equipment, method, market, man power, production, use, disposal and ancillary equipment.As far as petrochemical safety is concerned personal protective equipment and materials (PPEMs) that include garments, clothing, gloves, safety shoes, hard hats, safety glasses, shields, respirators, full aprons, safety belts, and other safety items which have to be used by an individual. Such equipment is important for personal protection and for safety. It is the manager's and supervisor's responsibility to ensure that they are used. The enactment of worker's compensation law and occupational disease law shall increase materially the cost of insurance to industry. The increased cost and the certainty with which it is applied will put a premium on accident-prevention work. This cost can be materially reduced by the installation of safety devices. Industrial research experience has shown that approximately 80% of all the accidents are preventable. EIA and EHIA processes have been conducted for a nuclear power plant to consider the safety and health impacts to mitigate psychological health loading on workers and nearby residents. SEA system is a potentially useful element of good environmental management and sustainable development; however, as currently practiced in industries, it is far from perfection as per the climate sensitivity factor. Emphasis should be given in industries on maintaining economic viability of the operation, while in turn taking care to preserve the ecological and social sustainability of the country. International EIA process required multi-disciplinary approach that has been conducted very early stage of Indo-Matsushita Midget electrode project 1982 at Tada for technical, economic, ecological and social sustainability.

Keywords: Climate, Conservation, Resource, Recovery, Nuclear, Climate Education, Embed, Environment, Quality, Industry, Management, Engineering, Technical, Economical, Sustainability

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1. Introduction

This research introduction discusses an importance of conducting environmental health impact assessment (EHIA) process for the project proposal of Nuclear Power Plants. There are more than twenty-four nuclear power plants situated in rural and urban areas situated in India having an installed capacity of 7500 MW including pressurized heavy water reactors and light water reactors. Nuclear Power Corporation of India Limited (NPCIL) has identified Rajauli in Nawada district of Bihar as the possible site for creation of 2000 MW nuclear

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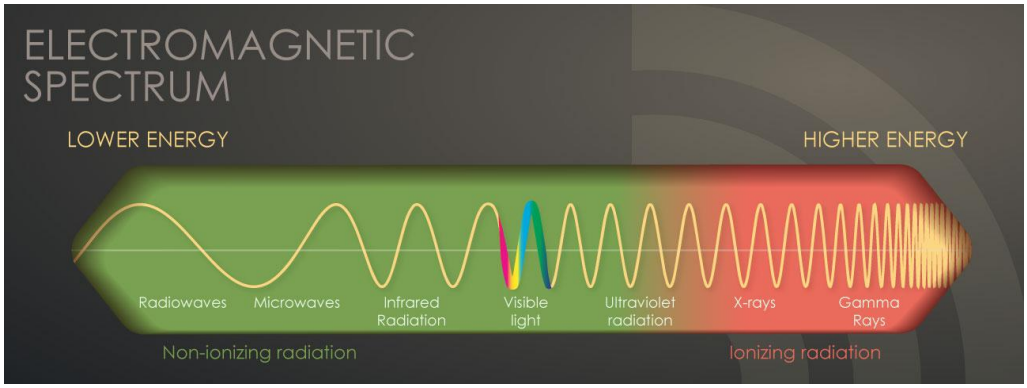
power plant proposal. It is also important to conduct EHIA process study to address psychological and neuroscience impacts on nearby residents at Rajauli in Nawada District, Bihar (Reference 1). The adverse environmental health impacts on nearby residents form certain types of projects, such as nuclear power plants to address Psychological impact assessment (PIA) process are mental adverse health effects, depression, anxiety, post-traumatic stress disorders, damages to mental health impacts including emotional somatic unsafe radioactive disorders on human being, animals and plant ecosystem. A high dose of ionizing radiation as shown in given below figure that can cause immediate damage to a person's body, including at very high doses, radiation sickness and death. At lower doses, ionizing radiation can cause health effects such as cardiovascular disease and cataracts, ulcer as well as cancer.



The ionizing radiation is a form of energy that acts by removal of electrons from atoms and molecules of materials that include air, water and land (LAW) interactions and interrelations and living tissues and organs. High energy short wavelength ionizing radiation can travel unseen and pass through LAW.

"Environmental Health Impact Assessment can be defined as the systematic identification and evaluation of the potential health impacts of proposed nuclear power projects, plans, programs, policies or legislative actions relative to the physical -chemical, biological, nuclear, cultural, and socioeconomic components of the total environmental health. EHIA which is a specialised terminology that is divided into most significant terms, Viz., "environmental health inventory ", "environmental health impact assessment " and " environmental health impact statement". The objective of the study and check are to conceptualize strategic environmental health assessment (SEHA) process for the generic, source specific and industrial sector in order to control climate change. Organizational planning and decision-making process should include the integrated consideration of technical or engineering, economic, environmental, safety, health, social and sustainability factors to achieve climate sensitivity environment. As per author's investigations conducted on EHIA during 4-5, November 2004 for the Qinshan Nuclear power plant, China Nuclear Power Co.Ltd., (CNPC), Qinshan that has been appraised and evaluated for safe nuclear environment compared to all twenty four nuclear power plants as it is a multi-unit nuclear power plant in Qinshan town, Haiyan county located in Jiaxing, Zhejiang province at China (Reference 1, World Engineers Convention Proceedings at Shanghai, 2004) . Nuclear radiation study has been conducted at CNPC and nuclear simulation and environmental health impact modelling including heat exchangers were investigated. Environmental technological perspectives on climate change mitigation in urban and rural environments are discussed with reference to nuclear safety called environmental health impact assessment (EHIA) process has been focussed for the nuclear power project at Bihar as a project proposal of NPCIL. Environmental health Impact Assessment process is designed and developed to identify and predict the potential environmental health effects of the physical, biological, ecological, socio-economic, cultural environment and on human health and well-being are adequately protected at Rajauli in Nawada District, Bihar. Strategic environmental health assessment (SEHA) process has been aimed in order to incorporate environmental quality (EQ) and sustainability factors in to organizational project planning and decision-making process. The primary purpose of the SEA process is to encourage the consideration of the environment, safety, health, social and sustainability factors in organizational planning and decision-making process and to arrive at actions that are compatible (Reference 2) .

SEA process protocol has been proposed for the EQ control. The health impacts of projects, plans, programs, or policies should be considered in the organization planning and decision-making process. Because of the importance of these concerns, particularly in developing and developed countries, environmental health impact assessment process is addressed. For certain types of projects such as nuclear power plants, it is necessary to address psychological, neurological, and physiological impacts on nearby residents and populations for the assessment and mitigation of mental illness in order to assess and mitigate mental health that is environmental health impact assessment and their components such as prediction and assessment of impacts on the air

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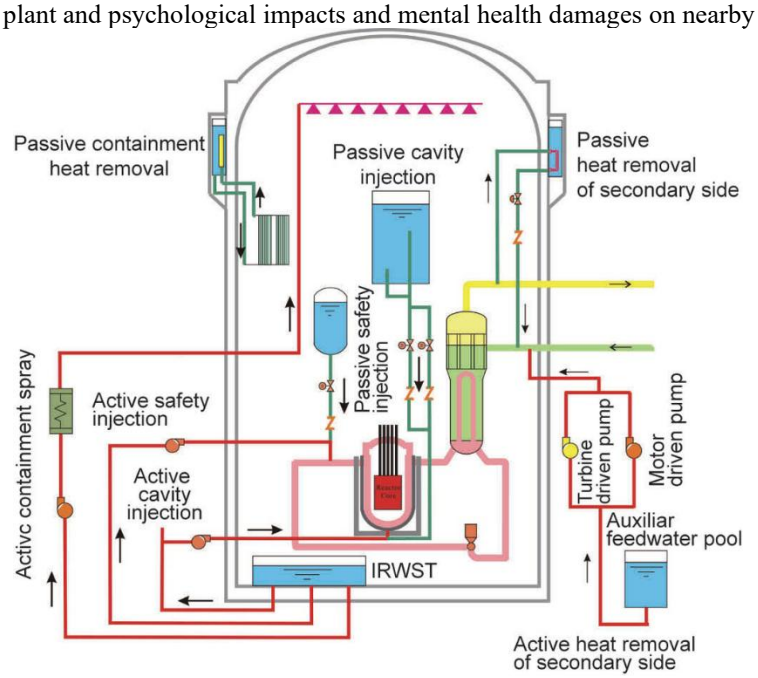
environment, surface water environment, soil and ground water environments, noise environment, biological or ecological environment, habitat based methods, cultural environmental impacts, architectural, historical and archaeological impacts, visual and aesthetic impacts, socioeconomic environmental health impacts including public participation on environmental health impact decision making process . The aim of the study is to conceptualize and develop SEHA and SEA processes for the control of climate change and environmental pollution. Social Impact Assessment (SIA) process can be defined as the systematic identification and evaluation of the potential social impacts (effects) of proposed nuclear power projects, plans, programs, or legislative actions such that social consideration in Rajauli is encouraged in project planning process and to arrive at actions that are socially compatible. This treaty and official government procedures of SEHA helpful for making much earlier in the decision-making process than EHIA process proposal of Nuclear Power Plant as depicted in given below nuclear power plant and psychological impacts and mental health damages on nearby residents of Rajuali.



The workers and mothers of young children are at risk of environmental health impacts such as depression, anxiety, psychosomatic, and post-traumatic symptoms about nuclear radiation exposures including stigma impact assessment nearby local residents. It is suggested to mitigate environmental health impacts due to psychological symptoms among village people, power plant workers, and medical program and awareness needed to reduce stigma, integration of psychiatric treatment and medical treatment (Reference 3) as the nuclear effect change damage of mental health and psychological impacts on nearby residents at Nuclear Power Plant Proposal of NPCIL at Rajauli, Nawada district of Magadh division of the State of Bihar (References 3,4,5,6).

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https://addiction-behavioral-conferences.magnusgroup.org/speaker/vijayan-gurumurthy-iyer
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https://plantbiologyconference.com/speakers/2022
https://plantbiologyconference.com/speakers/2023
Keynote presentation held on 16 th March 2023, GMT Timings 10:50-11.20 (IST : 16.20-17.00) Organized by Magnus Group LLC, Chicago, USA.
https://issuu.com/vijayangurumurthyiyer/docs/7_th_edition_of_global_congress_on_plant_biology_a
https://www.youtube.com/watch?v=ICkawk7l0lc

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The resource conservation and recovery (RCR) method has been devised prior to the conduction of environmental impact assessment (EIA) process.

The legislation of EIA process was established in 1970 by the enactment of the National Environmental Policy Act (NEPA) in the USA **(**Larry W.Canter, 1996**)**. This was first time that EIA process became an official tool to protect the environment. Three of the significant terms while complying with the requirements of NEPA process are "environmental inventory", "environmental impact assessment process", and"environment impact statement". EIAs of resource conservation and recovery of industries were undertaken in order to protect environment during the year 1950 in Japan, Europe and North America (Glynn Hendry J and Gary Weinke, 2003**)**. The purpose of the EIA process is to encourage the consideration of the environment in organizational planning and decision making process. Historically, the choice of proposed projects, policies, plans, programs, permits, procedures or legislations was primarily based on only one criterion called economic viability. Today, it is necessary to consider three criteria of economic, environmental and social viabilities in order to prevent global warming and ozone layer depletion potential. Integrated solid and hazardous waste management method for recycling of waste is recommend for climate change and control. Environment quality management (EQM) is an integrated solid and hazardous waste management approach that was the targeted research area in order to achieve socio-economic improvement and sustainability based on the triple bottom-line approach (economical, environmental and social) feasibility studies (Vijayan Gurumurthy Iyer, 2016).

2. Materials and methods

SEA process is a predictable process that is devised in to two phases (Vijayan Gurumurthy Iyer, 2015). The first phase is called initial environmental and sustainability evaluation (IESE) and the second phase is environmental and sustainability impact studies (ESIS). IESE has been carried out for Japanese Matsushita carbon company's proposed project, plan, program, policy, permit, procedure, and legislative action in India to determine whether potentially adverse effects on environment and sustain efficacy with respect to physical, chemical, biological, economical, socio-economic environment and on human health and well-being are significant or whether mitigation measures can be adopted to reduce or eliminate adverse environmental and sustainability impacts. Detailed SEA procedure can be called as ESIS that was applied toidentify and evaluate the environmental and sustainability consequences both beneficial and adverse impacts in order to ensure that the environmental and sustainability impacts were taken in to consideration in organization's planning and decision making process. SEA process is designed to identify and predict the potential impacts of the physical, biological, ecological,

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socio-economic, cultural environment and on human health and well-being are adequately protected (Vijayan Gurumurthy Iyer, 2011). Given below some of the methods and techniques applied for the sustainable project formulation and appraisal for the various projects such as midget electrode (Battery carbon rod) project, industries, nuclear power plants and natura of project (Vijayan Gurumurthy Iyer, 2015) as per integrated solid and hazardous waste management approach.

1. Expert judgment and stakeholders' sentiments
2. Check list and matrices
3. Multi criteria analysis
4. Case comparisons
5. Simulation models
6. Software and information system
7. Questionnaires
8. Group discussions
9. Delphi approach
10. Flow charts and decision trees
11. Contingency analysis
12. Overlays
13. Fuzzy logics

Environmental quality and sustainability compliance requirements have been identified and evaluated systematically in these projects (http://debm-ediiindia.ac.in/counsellors/student record). Fifteen DPRs of DEBM Learners were formulated and appraised (http://www.ediindia.org/doc/list of institutions for website_latest.pdf.serial number68). (http://debm.ediindia.ac.in ; Agency code: 80410, Password: 80410)(Vijayan Gurumurthy Iyer, 2015) and BIPARD course modules.

2.1 Step-wise Structure of SEA Process

SEA Process has been itemized by the following nine steps.

1. Preliminary activities and decision of Terms of References (TOR)
2. Scoping
3. Study of baselinedata
4. Strategic environmental assessment and evaluation,
5. Evaluation of alternative measures
6. Assessment of alternative measures
7. Preparation of final documents
8. Decision-making
9. Monitoring, measurement and control opportunities for resource transformation and project implementation and its strategic environmental assessment process.

2.2 Conceptual Framework for Screening and scoping of SEA Process

Screening and scoping processes are the items which are employed in the SEA processes (Figure-1) .

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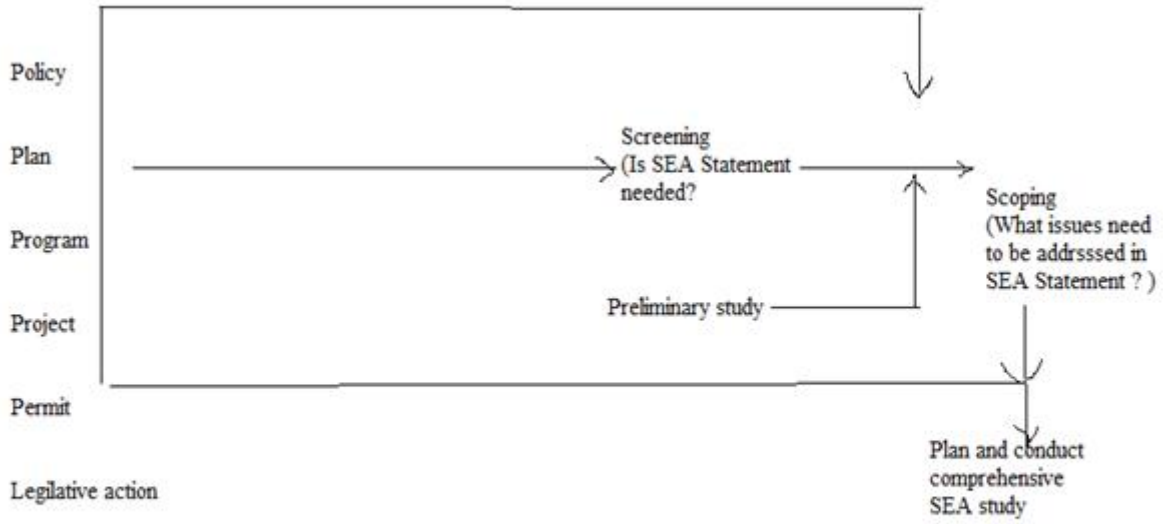

Figure-1: Conceptual Framework for Screening and Scoping Processes of SEA Process

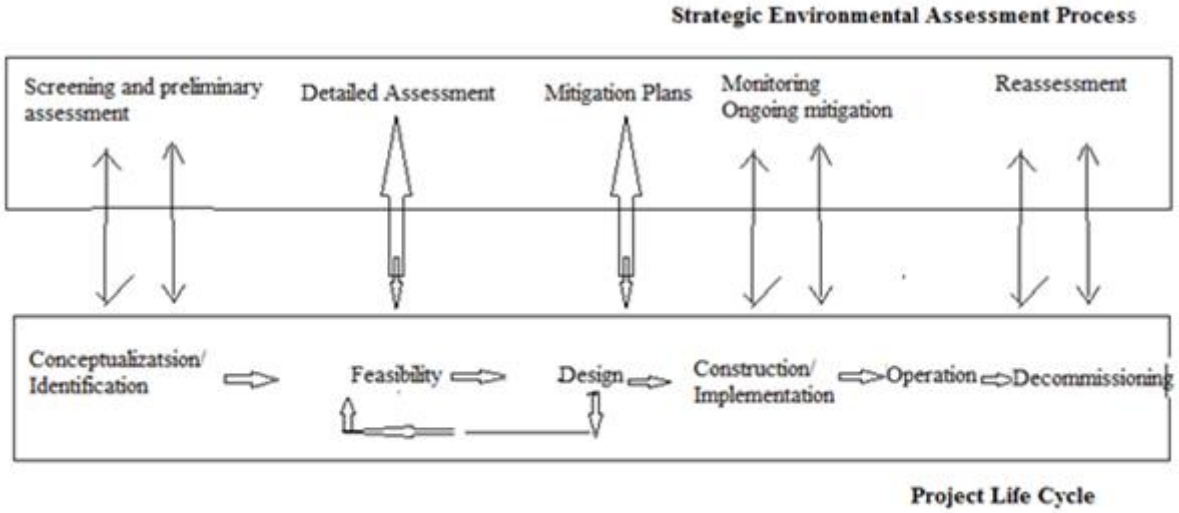

Figure-2: Strategic Environmental Assessment (SEA) Process at Different Phases of Project Life Cycle Assessment

Three most significant items are," Strategic environmental assessment inventory, environmental impact assessment, strategic environmental impact assessment statement. Petrochemicalplanning and decision making process should include the integrated environmental quality consideration of technical, economic, environmental quality, social, safety, health and sustainability factors (Figure-2).

2.3 Strategic Environmental Assessment Management Plan (SEMP)

A strategic environmental assessment management plan is a detailed plan and schedule for measures to minimize and mitigate any potential environmental and sustain efficacy impacts. SEMP should consists of a set of measurement, monitoring, control (mitigative) and institutional measures to be taken during the implementation and operation of the proposed projects to eliminate adverse environmental and sustainability impacts, offset them or reduce them to acceptable levels. Strategic environmental assessment process aims to incorporate environmental and sustainability considerations in to strategic planning and decision-making processes of the project formulation and appraisal. International EIAs are important considerations in project planning and decision making process (Vijayan Gurumurthy Iyer, 2010) as an integrated solid waste management approach. It

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has been imperative to consider international EHIAs in nuclear projects and thermal power stations to mitigate nuclear pollution and thermal pollution including petrochemical volatile organic compounds cum CO_2 -induced climate warming and stratospheric ozone layer depletion problem. International EIA process is a potentially good environmental quality management (Glynn Hendry J and Gary Weinke, 2003) .

3. Results and discussions

During the last two centuries due to the fast urbanization and industrialization along with advancement of Science, Engineering and Technology, there have been considerable developments in industrial sector with the resultant 80% wastage of copious amount of resources and tremendous environmental stress due to green house gas emission, ozone layer depletion gases and RCR possibilities. Subsequently, it was realized that there were many adverse impacts on environment and society. These unsustainable petrochemical developments have sustained the environmental growth (Vijayan Gurumurthy Iyer, 2010). Environment and Sustainability of design and development of industrial, generic, and source specific sectors, quality of life, safety on earth and continuous process improvement of our environment quality (EQ) is of utmost important. Sustainable development be defind as a kind of development that should occur without damages to the environment. Hence, hectic petrochemical developmental activities during the last two centuries have caused considerable environmental and social impacts as shown in figure 3 and 4. Vijayan Gurumurthy Iyer (2022) mentioned that the root cause problem solution for ozone layer depletion potential (OLP) impact, global warming potential (GWP) impact and green house synergic (augmentative) gas (GHG) emission impact in context to petrochemical industrial plants are measured, monitored and mitigated by international environmental impact assessment process (Figure-3) for the sustainable environmental climate change and control.

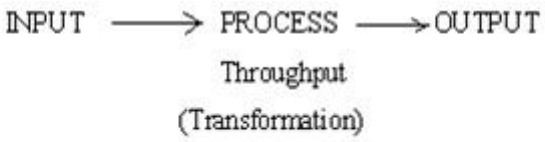

Figure-3 : Construction Management by Process Approach

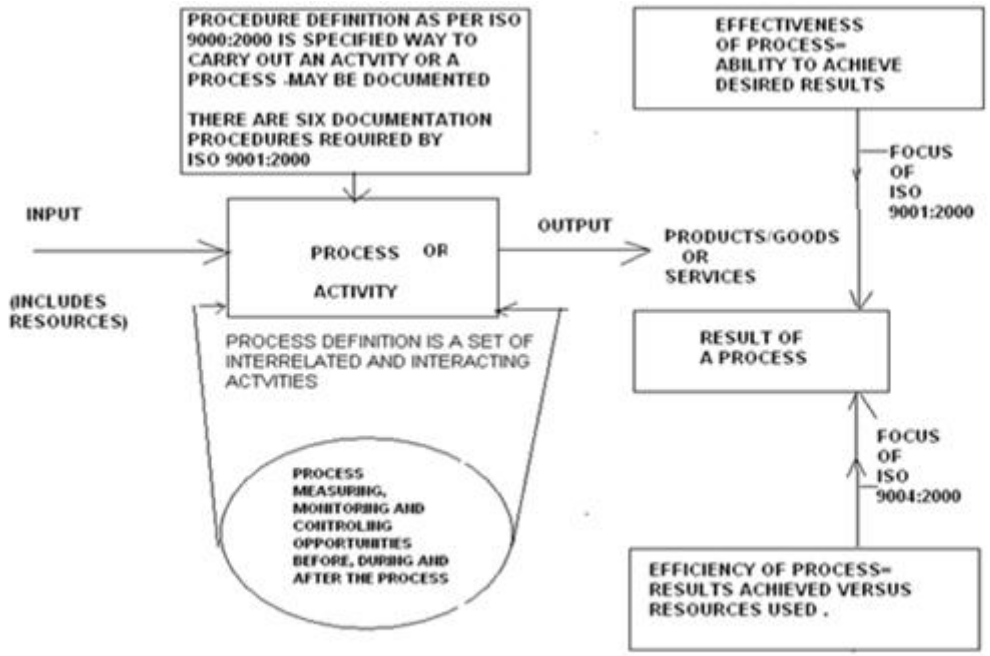

Figure-4: Schematic Diagram of a Construction Process

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International EIAs are important in international project planning and decision making process that mitigates potential environmental impacts in more than one country (Vijayan Gurumurthy Iyer, 2010). The use of sustainable technology and management in environmental and sustainability matters in two areas that is sustainable development with global problems and prevention technologies that are designed to reduce the environment quality effects of products and processes (Figure-4).

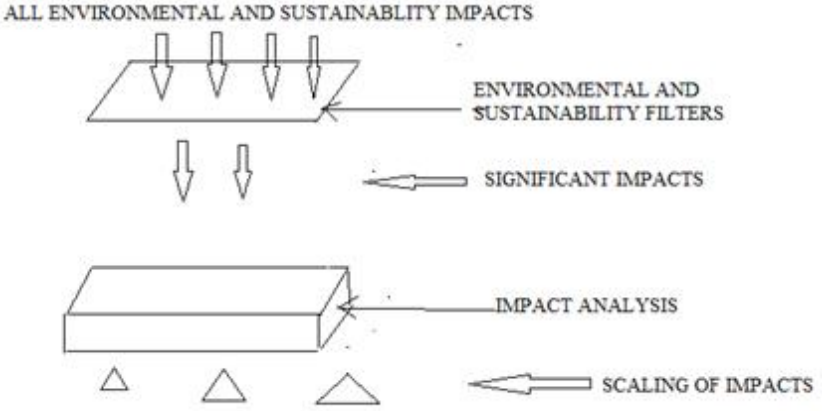

Figure - 5: Procedure for finding out the Significance of Environmental and Sustainabilty Effects

The integration of environmental quality protection and economic development is the most important strategic environmental assessment tool in achieving sustainable development (Figure-5)

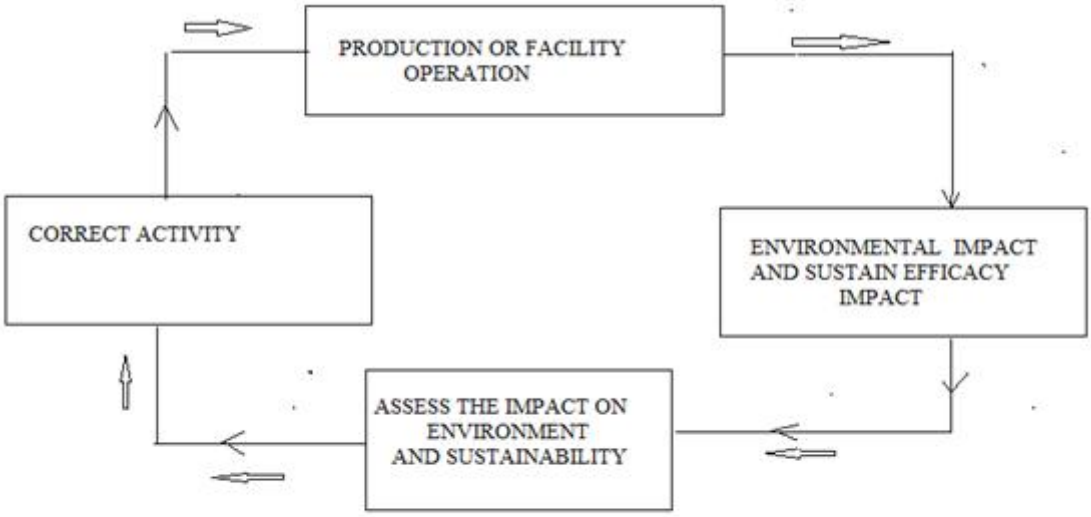

Figure-6: Environmental and Sustainability entitled" After-the -fact" evaluation

Project planning and decision-making should include the integrative consideration of engineering or technical, economic, environmental, ethical and social factors. A midget electrode project was taken as a case study for the strategic environmental assessment process (Figures-5 and 6). International EIA process has been designed for the sustainable midget electrode project design and sustainable plant design to identify and predict the potential effects of the physical, biological, ecological, socio-economic, cultural environment and on human health and well-being are adequately protected. Environmental Impact Statements (EIS) have been prepared for the project which considering environmental and socio-economic factors with respect to development and other proposed actions. Therefore, the EIA system is a potentially useful component of good environmental quality management (Glynn Hendry J and Gary W.Heinke, 2002). In chromium tanning industry, chromium environmental contamination and pollution has discharged beyond safe limitswhich seriously affects the life on the earth (Vijayan Gurumurthy Iyer, 2007). Toxic emissions from industries, thermal power plants, smelting pollution, auto exhaust pollution in large metropolitan areas, photo petrochemical smog have been poisoning the atmosphere beyond the permissible levels which causes serious health hazards. Air pollution causes adverse

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environmental health and social impacts. Sload waste disposal of untreated petrochemical industrial wastes and odissa chromite mines and other radio-active wastes in nuclear power plants, petrochemical debris, saniatary wastes, hazardous wastes, municipal solid wastes, agricultural wastes, domestic wastes have contaminated and polluted the water, soil and land beyond the tolerable limits, which adversely affects land fertility, water quality, vegetation, aquatic and marine life (Vijayan Gurumurthy Iyer, 2011). This is proving more and more non-hazardous green house emissions and hazardous ozone layer depletion as this development continuously damaging the environment quality viz., climate sensitivity factor in urband rural areas, melting of glaciers to 50 inches, increase of hybrid distaster risk, petrochemical smog, greenhouse gas emission, ozone layer depletion. For example, due to continuous increase in CO_2, methane, and nitrous oxide oncentration in the atmosphere due to industrial emission of about 420 ppm CO_2 which lead to climate change, climate heat change to 15.2 degree centrigrade . Addition of greenhouse gases to the atmosphere, the average sea level around the World by the 2023 and melting glaciers contributes to about 29.5 % of mean sea level rise since 1991.

Water supplies stored in the glaciers were projected to decline. Besides contaminating and polluting air, water, soil and land, the intensive technological activities lead to depletion of natural resources (Vijayan Gurumurthy Iyer, 2011). Sustainable solid and hazardous waste management method is recommended. This must have been required to bring our energy and intellectual capacity in tandem whereby that can meet the challenge efficiently without major disruption as well as without compromising on the livelihood of future generation of their needs. Development would have occurred without damages to the environment and major disruption, and the process of urbanization and industrialization would have occurred in sustainable manner by utilizing the resources efficiently. Now, these environmental quality problems are the present environmental challenges and opportunities for improvement. In order to overcome these environmental problems that shall require new and more efficient solutions, technologies, processes and products alongside behavioral change. Low carbon and energy efficient technology of petrochemical industries can make contributions to mitigating impacts of economical growth on global warming (Figure-7) (Vijayan Gurumurthy Iyer, 2014). The resultant output of green products and services which are environmental quality advantages with good performance and cheeper prices. The dual goals of green design are the waste prevention and better material management as depicted in Figure 7. Design of green buildings that has considerably reduced the environmental impacts associated with manufacturing, use and disposal (VijayanGurumurthy Iyer, 2015).

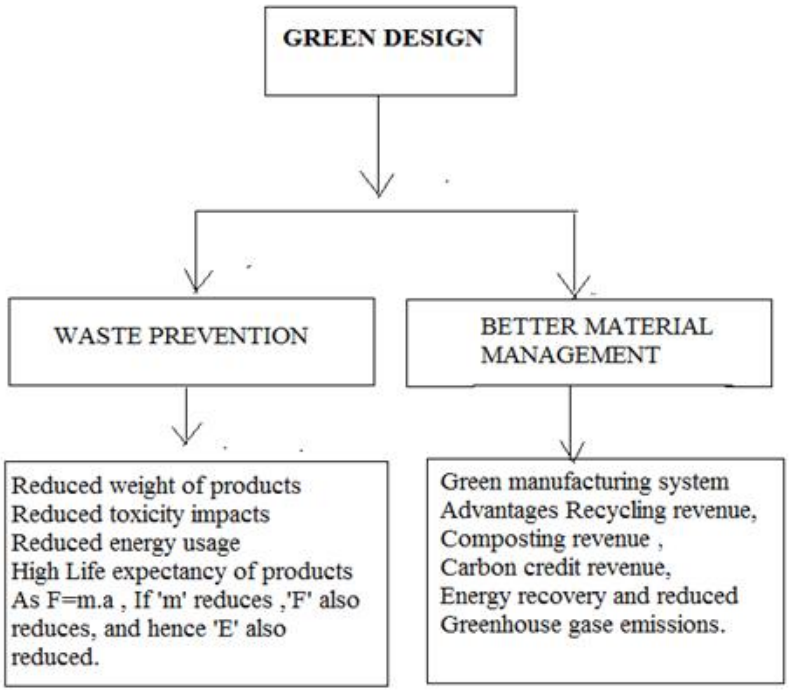

Figure 7 : Dual Goals of Green Design and Manufacturing Process

Prior to the enactment of National Environmental Policy Act on Environment in1970 in the USA, only technical or engineering and economic factors dominant in planning and decision-making process in most of the world

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projects, plans, programs, permits, policies and legislative actions. As per the research results that project planning anddecision-making process must include the integrated consideration of engineering or technical, economic, environmental, safety, ethical, social and sustainability factors. This important consideration can be referred to as "Concept of the Four Es and 1 S" in organizational planning and decision- making process. There are ecological and biogeochemical principles and tools such as energy flows and material cycling, element ratios, mass and energy balance, element cycling, product environmental lifecyle assessment (LCA)(Figure-8) are available in order to solve major environmental problems that we face in our world today such as global warming, acid rain, environmental pollution and increasing greenhouse gases.

3.1 Product environmental lifecycle analysis (LCA)

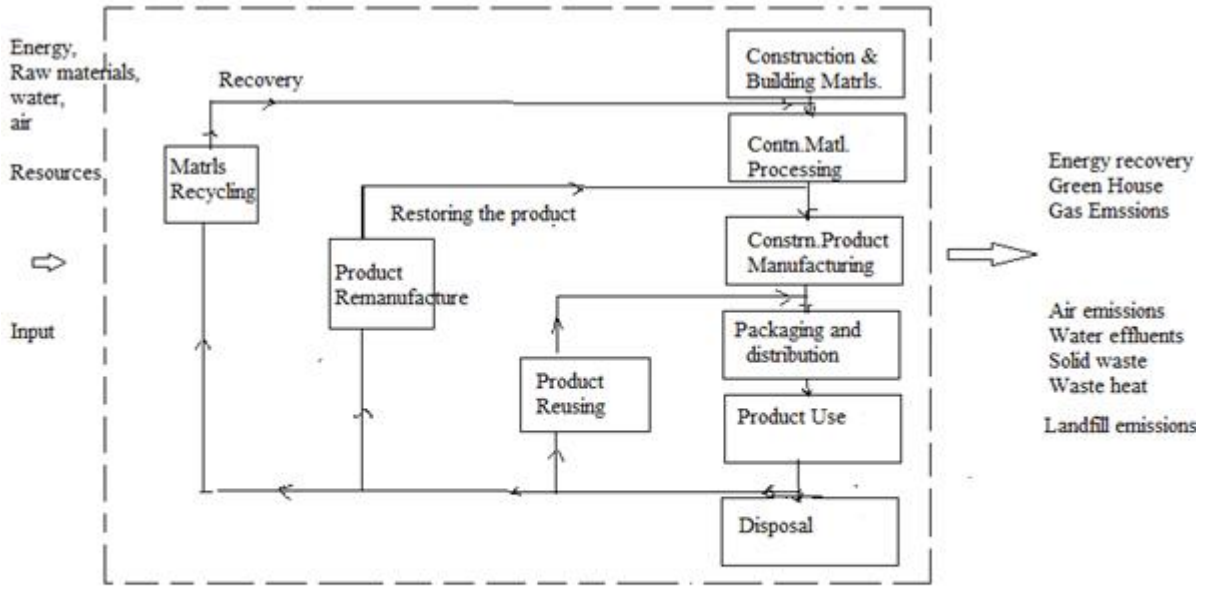

Figure - 8: Construction Product environmental lifecycle analysis (LCA)

Case study on petrochemical product environmental lifecycle analysis (LCA) is assumed for identifying and measuring the impact of industrial products on the environment and sustain efficacy by means of mass and energy balance methods(Figure-8) (Vijayan Gurumurthy Iyer, 2016) including resource conservation and recovery and solid and hazardous waste management and environmental impact assessment process . LCA consider the activities related to extraction of raw materials, ancillary materials, equipment production, use, disposal and ancillary equipment (Glynn Hendry J and Gary W.Heinke, 2002).

3.2 Environmental Health Impact Assessment (EHIA) Process for Petrochemical and Nuclear Power Plant Project Towards Sustainable Climate Change and Control Development

An environmental health impact assessment (EHIA) process is proposed in this research for nuclear power plant project during the petrochemical phase in order to address psychological health impacts on workers and nearby residents(Vijayan Gurumurthy Iyer, 2016). Environmental health impact assessment can be defined as the systematic identification and evaluation of the potential environmental health impacts or effects of proposed nuclear power projects, plans, programs, policies or legislative actions relative to the physical-chemical, biological, cultural and socioeconomic components of the total environment. At present there are more than four hundred thirty-seven nuclear power plants situated in the World. It may be worth mentioned that none of the nuclear power projects, plans, programs, policies, or legislative actions in the World have got sustainable practice in conduction of EHIA process (Vijayan Gurumurthy Iyer, 2016). Nuclear power plants generate electricity using heat generated in pressurized water reactors where nuclear reaction takes place. The author of this paper has conducted experimental simulation and modelling study at China's Quinson Nuclear Power Plant which use Uranium-235, Thorium-232 and Plutonium-239 as fuels in nuclear reactors causing pollution (Vijayan Gurumurthy iyer, 2004, World Engineers' Convention (WEC) at Shanghai, November 2004) . That time copious amount of radiation dose due to radioactive pollution escaping out in the order of about 120 billion Becquerel (120 GBq) to 240 billion Becquerel (240 GBq) that is 50 grams to 100 grams, radiation activities viz.,

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Alpha (α), Beta (β) and Gamma (γ) as against the safe limits of 0.1 Bq /l or Bq/kg (ppm) in land, air and water when operation, repair and maintenance of replacing old nuclear fuels with new fuels taken place . High exposures to radioactive pollution damage mental health and psychological burden on workers and nearby residents. As per a psychological health impact survey conducted by the author in a nucelar power plant at Quinson, China, severe psychological disorders including radioactive poisoning, depression and post-traumatic stress have been investigated to an extent among 49% of the nearby residents in and around 82% of the nuclear power plants in the World (Vijayan Gurumurthy Iyer, 2004)(World Engineers' Convention,Shanghai,China-2004) . Psychological health impact loadings due to radioactive environment on workers and nearby residents have been studied in this research during the test run phase using computer simulation models. Psychological health impact assessment (PHIA) on workers and nearby residents have been addressed to mitigate psychological health impact loadings on workers and nearby residents.

3.3 Environmental Health Impact Assessment (EHIA) Process for Sustainable Nulcear Power Development

In this research, sustainable petrochemical process, efficient integrated solid and hazardous waste management practice, EHIA process have been investigated. Reseacrh work has been done on cotton double roller (DR) ginning industries using chrome composite leather clad (CCLC) washers and design and development of an eco-friendly alternative(Vijayan Gurumurthy Iyer, 2007). The objective is to assess the environmental health impacts of Indian cotton ginning industries. Most of the cotton ginning operations are performed by using DR ginning machines which serve an important role in the Indian cotton ginning industries. The rollers used are made of CCLC covering fixed to a shaft. The CCLC contains about 18,000 to 36,000 mg/kg (ppm) of chromium particles (Vijayan Gurumurthy Iyer, 2007).. When the seed-cotton is processed in DR ginning machine, the lint cotton is contaminated with hexavalent chromium dust of about 140 to 1990 mg/kg (ppm) which is carcinogenic substance against the safe limits of 0.1 ppm. During the cotton ginning process due to persistent rubbing of CCLC over stationary knife the chromium particles are adsorbed into lint cotton such that the spun yarns and woven fabrics get contaminated about 100 to 200 ppm which according to World Health Organization (WHO) eco-standards should not be more than 0.1 ppm. The CCLC rollers used in cotton roller ginning machines get powdered during the ginning process. As chromium is a specific dust, gin and mill workers and residents are directly exposed to this carcinogenic substance and are vulnerable to environmental health hazards. To offset this problem, pollution-free eco-friendly washers/rollers both for laboratory and commercial studies have been fabricated and experimented. Environmental health inventory (EHI) serves as the basis for evaluating the potential environmental health impacts both beneficial and adverse of a proposed action. Environmental health impact statement (EHIS) describes the affected environmental health or environmental health setting without the project. Design and development of the EHI is an initial step in the EHIA process. It is concluded that EHIA process should be conducedfor certain projects, plans, programs, legislative actions, policies in the project planning and decision-making process.

3.4 International EIA Process

International EIA process is a potentially good environmental management system (EMS). International organization for Standardization (ISO)'s 14000 and 9000 standards focus on Environmental Management System (EMS) and Quality Management System (QMS) of all sorts of organizations apart from more than 19500 published standards. Environmental Management System (EMS) and Quality Management System (QMS) have been separately featured in ISO. Environmental Management System (EMS) standards apply to the management system concepts of an organization's environmental issues and opportunities (Giri.,C.C. et.al.,2003). It defines the features of an EMS that need to be in place to ensure that the organization identifies and focuses on improving areas where they have significant environmental impacts. This system can be integrated with ISO 9000 Quality Management System (QMS) standards to achieve excellence in quality as well as environmental obligations. The overall aim of the EMS is to provide protection to the environment and to prevent pollution so as to manufacture eco-friendly products and services. EMS focuses on key drives of performance excellence in products and processes as well as organizations that are focused on delivering values to the customers, internal operational processes, and to staff's learning environment. Hence, this system approach to the environmental quality management shall achieve excellence in the overall performance of the organization. In the present study about two third of petrochemical waste was recyclable recoverable due to the conduction intensive on-site integratve training programmes on recycling and composting processes as against the conventional management practices which could able to recover the waste of only 10 from 65%(Vijayan Gurumurthy Iyer, 2014).

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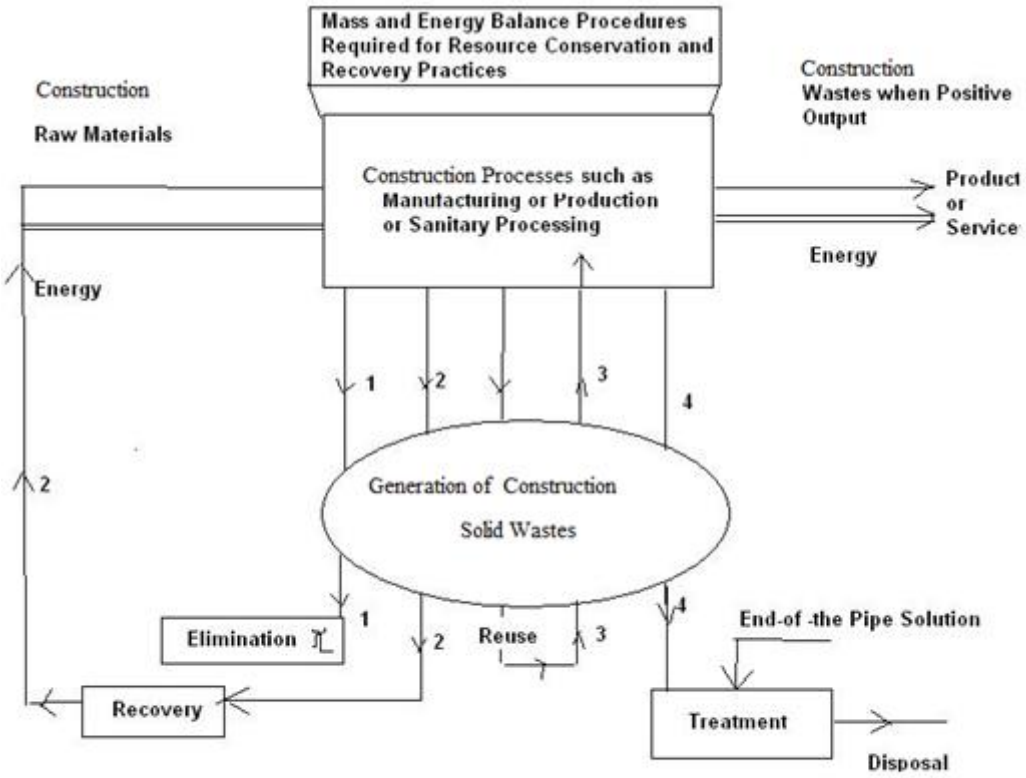

Figure- 9 : Schematic Representation of Constructional Process or Activity Showing Sustainable Construction Waste Management

Petrochemical wastes are produced by petrochemical sector. The study has been attempted to identify and evaluate special waste minimization hierarchy of waste management for properly managing petrochemical waste including minimizing generation and treatment that have been generated, and disposing of waste residuals. A case study has been included on generation of petrochemical wastes and potential waste management strategies for a group or generic petrochemical processes. All petrochemical processes generate wastes in the form of liquids, solids or gases. Some wastes are considered as hazardous. The waste minimization hierarchy of waste management is duly ranked from most desirable to least desirable (Figure-9) . 1. Eliminating waste generation – Most desirable, 2. Reducing waste generation- Most desirable, 3. Reuse, recover or recycle waste materials- Most desirable, 4. Treating waste to diminish quantity and to detoxify the hazardous and non-hazardous solid wastes --Least desirable, 5. Disposing of waste residuals- Least desirable. Waste minimization include only elimination, recovery, reduce, reuse and recycle hierarchies. Waste minimization does not include treatment of wastes as well disposal that is point number 4 and point number 5 because, these are traditional waste control strategies involves treatment and disposal which are called end-of-the pipe solutions and are costly affairs as well as involve control of high discharge standards . Modern waste control strategies involve point number 1, point number 2 and point number 3 which are not requiring end-of- the pipe solution for the waste management problems. Solid and hazardous waste generation is the sum of material recovery and discards. Report on waste audit conducted for a petrochemical industry is presented for recovering two-third of municipal solid wastes (MSW) by recycling and composting processes (Figures- 10 and 11)(Vijayan Gurumurthy Iyer, 2014).

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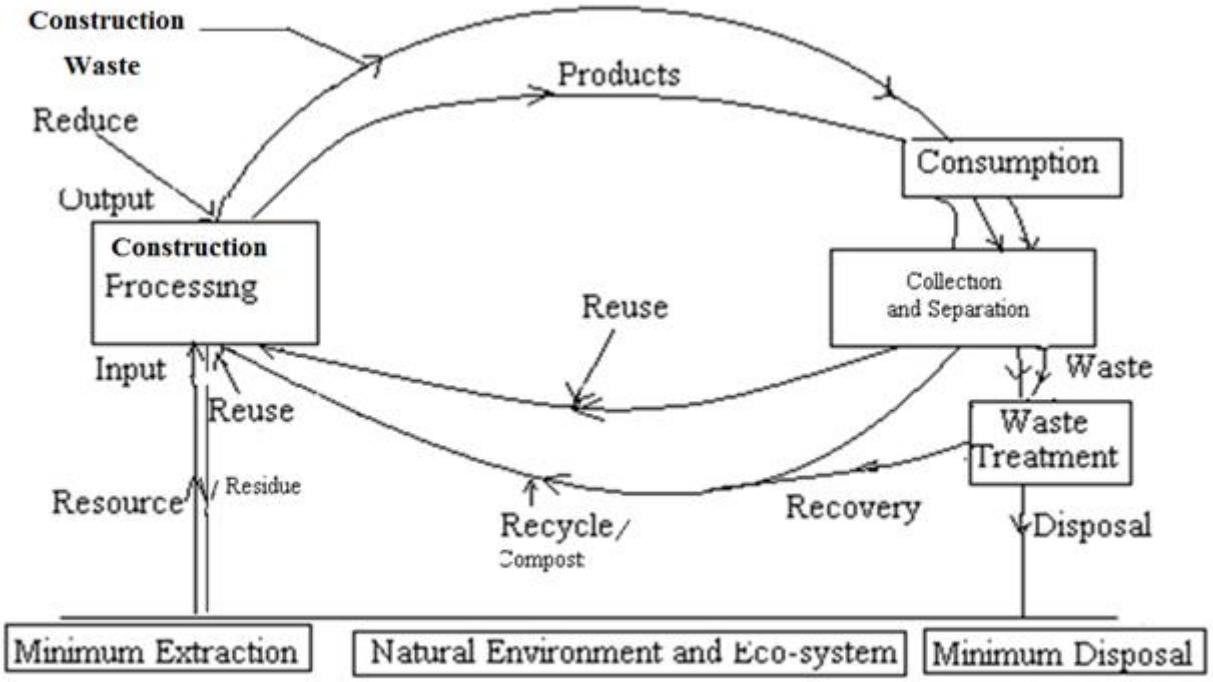

Figure -10 : Closed Loop-Shaped Green Economy for Sustainable Construction Waste Mgt.

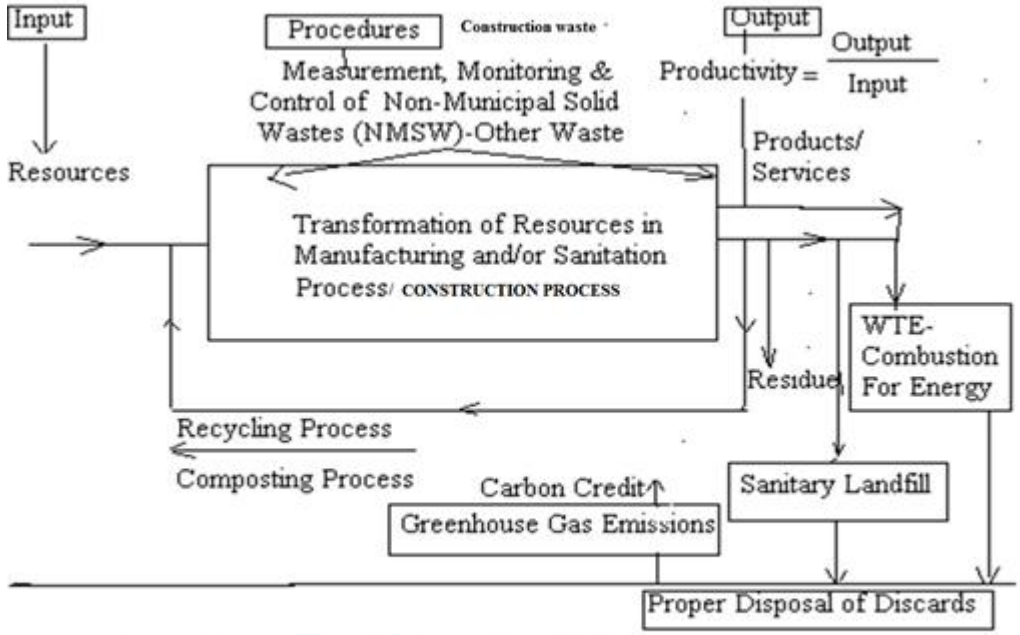

Figure - 11: Sustainable Construction Waste Management System

To achieve the sustainable economical improvement, natural resources to be utilized at optimum levels such as resource conseration and recovery as to maximize efficiency as per the result analysis of optimum competitive and social markets. The efficiency of a kind of sustainable economical system is referred in "*A.K"* sustainable economic model that is the product of engineering or technical factor level (A) and the capital (K). The sustainable economic improvement is explained by three factors which are given below :-

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1. The natural increase in the accumulation of labour potential,
2. Capital accumulation or money with which a business is started and run,
   and
3. Sustainable technological momentum can be referred as total factor productivity (TFP) or efficiency in petrochemical process.
   Such momentum keeps the capital development dynamic which emerges from the sustainable enterprise creation process, green products or services, new methods of production and processes, new petrochemical maangment and transportation, new markets and new forms of petrochemicalorganization.
   Standard Production Function (SPF) is expressed based on operation approach as
   $Y = f(C, L)$
   Where Y=Output, C=Capital, and L=Labour
   As knowledge is a crucial factor for the economic growth,
   Standard Production Function (SPF) is modified based on process approach as $Y = A.\ f(X_1, X_2, X_3, X_4, X_5, X_6 \ldots\ldots\ldots\ldots X_n)$
   'A' represents Knowledge on sustainble petrochemicalengineering or technical factor, Y= Output,
   Input elements are namely, man power, machinery, materials, method, money and market denoted as $X_1, X_2, X_3, X_4, X_5, X_6 \ldots\ldots\ldots\ldots\ldots X_n$,
   f = Standard production function.
   As per the given standard production function, knowledge is a decisive production variation, sustainable innovation level is required in engineering or technical system. The solution is the development of reformed SEA implemented petrochemical industries (Vijayan Gurumurthy Iyer, 2015).

3.5 Importance for the Conduct of Resource Coservation and Recovery Study and Environmental Impact Assessment (EIA) and Management for the Petrochemical Projects Historically, the choice of new petrochemical projects was primarily on one criterion, which is economic viability. Presently, second and third choice criteria that is environmental and social impact have become a strong yardstick, therefore a triple bottom-line approach that is economic, environmental and social factors to petrochemical project viability. Environmental Impact Assessment (EIA) process is a systematic identification and evaluation of potential effects of proposed projects, plans, programs, plans or legislative actions relative to the physical-chemical, biological, cultural and socio-economic components of the total environment.

3.5.1 Steps to Conduct Environmental Health Impact Assessment and Management

Step-1: Identification of quantity and quality characteristics of concerned environment of proposed project.
Step-2: Preparation of description of existing environmental resource conditions.
Step-3: Procurement of relevant quantity and quality standards.
Step-4: Impact predictions,
Step-5: Assessment of impact significance,
Step-6: Identification and incorporation mitigation measures.

Conduct of Environmental Health Impact Assessment (EIA) Study For the Efficient Industrial, Muncipality and Agricultural /Rural Development Projects

1. Prediction and assessment of impacts on surface water environment,
2. Prediction and assessment of impacts on soil and ground environment,
3. Prediction and assessment of impacts on the air environment,
4. Prediction and assessment of impacts on the noise environment,
5. Prediction and assessment of impacts on the biological environment,
6. Prediction and assessment of impacts on the visual environment,
7. Prediction and assessment of impacts on socio economic environment. Prediction and assessment of impacts on cultural environment,
8. Prediction and assessment of impacts on archaeological environment,
9. Prediction and assessment of impacts on anthropological environment

3.5.3 Benefits of EHIA for Industries

1. Considerable reduction inwaste and the depletion of resources.
2. Considerable reduction and / or elimination of the release of pollutants in to the environment.
3. Green design and green building products to minimize their environmental impact in Production, use, and disposal.
4. Control the environmental impacts of sources of raw material.
5. Waste minimization and adverse environmental impact of new developments.
6. Promote environmental awareness among employees and the community.

3.5.4 Environmental Quality Management Programs

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The organization shall establish and maintain a program(s) for achieving the environemntalobjectives and targets. It shall include designation of the responsible function, team, or individual and a time frame for achievement (Giri.,C.C. et.al.,2003)..

1. State the objective / target.
2. State the purpose (how the objective/target will support the policy).
3. Describe how the objective/target will be achieved.
4. State the program (team) leader.
5. Designate departments and individuals responsible for specific tasks.
6. Establish the schedule for completion of the tasks.
7. Establish the program review, which will include format, content, and review schedule.

3.6 Conduct of Social Impact Assessment (SIA) Study

Social Impact Assessment (EIA) process is a systematic identification and evaluation of potential social effects of proposed projects, plans, programs, plans or legislative actions relative to the society. The purpose of the SIA process is to bring about a sustainable and equitable biophysical and human environment (Vijayan Gurumurthy Iyer, 2022). SIA process includes the monitoring, measurement and control opportunities including analysis and management of the intended and unintended social consequences whether both positive and negative impacts of planned interventions and any changes takes place in social transformation process invoked by those interventions. The SIA process should include the analysis of the use of land, culture, industrial process, economic development, and their impact on service sectors such as water use, energy use, sanitation and traffic. SIA process is done to ensure that there is no mismatch between the petrochemical development and socio-cultural and economic development of the project areas.

3.7 Sustainable Waste Water Quality Management

Water quality is to be maintained in petrochemical sites such that water supply to consumers is safe and hygiene. Relevant water quality standards are to be followed (Ralph A.Wurb,2003). Sustainable sanitation facilty is to be provided. Sanitation impact assessment study has been conducted for saniation proejcts and plans. Sewerage system, storm water drainage systems, waste water treatment system, industrial waste treatment system, sustainable septic tank are important onsite requirments. Relevant waste water discharge standards are to be followed. Process approach for measurement, monitoring and control opportunities for water, waste water and industrial water water quanity and quality has been followed(Mtcalf Eddy, 2012) at petrochemical sites.

3.8 Safety Engineering and Management in Nuclear Power plants (Safety First)

Cast study conducted at China's Quinson Nuclear Power Plant

Safety management is the systematic identification and evaluation of potential safety requirments of proposed projects, plans, programs, plans or legislative actions. The purpose of the safety engineering and management is to bring about sustainable design of petrochemical projects considering Resource conservation and recovery aspects and EHIAs. It has been observed that some petrochemical methods and machineries used in India are to be obsolete and outdated because they were old which operated on poor performances in terms of productivity, quality, efficiency and safety. Some of the alternative machineries, which are indigenously manufactured, also do not guarantee for the superior performance and necessary safety conditions because of their poor design and materials of petrochemical . It is mandatory that checking for safety requirements with regard to machineries, bridges, roads and buildings. Safety personnel responsible for overseeing the safety of all operating personnel must be cognizant of the latest laws and regulations pertaining to worker safety and occupational health (Pascal M.Rapier and Andrew C.Klein,1998). These are changed and/or updated from time to time.Checking for Safety (CFS) such that to ensure that the question of safety will not be overlooked, it is well to have all plans, specifications and drawings checked for safety, making special provision for this in each set of specifications and in the title plate of each drawing duly checking periodically for cranes, hoists, ventilation, lifts, tackles, fire protection systems, alarms, buildings, mechanical guarding and elecgtrical and electronic equipment and heavy engineering equiments. Personal protective equipments (PPEs) and materials include garments, clothing, gloves, safety shoes, hard hats, safety glasses, shields, respirators, full aprons, safety belts, and other safety items have to used by an individual (Pascal M.Rapier and Andrew C.Klein,1998). Such equipment is important for personal protection and for safety. It is the manager's and supervisor's responsibility to ensure that they are used. As far as occupational-disease prevention is concerned that those persons engaged in or working near operation are exposed to appreciable quantities of dusts, fumes or gas, it is important that adequate control measures must be adopted. Some major considerations involved in the application of effective control to industrial occupational disease are given. Some of the policies, practices, and procedures to prevent exposure of personnel to unsafe materials are also provided. As far as the worker's compensation law is concerned, it must be enacted strictly in our country. The principle involved is that the worker injured or disabled in industries should be enabled,

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through proper medical treatment, to return to wage-earning capacity as promptly as possible and while incapacitated, should receive compensation in lieu of wages, and regardless of fault. The expense of medical treatment and compensation should properly be borne by industry and become a part of the cost of its products. The laws generally provide that workers injured in industry shall be furnished the necessary medical treatment, and, in addition, compensation based on a percentage of their weekly wages, payable periodically. Dependants of employees kill in industry are likewise compensated. Occupational diseases law provides provisions for compensation benefits in occupational – disease cases. The enactment of worker's compensation laws and occupational disease law shall increase materially the cost of insurance to industry. The increased cost and the certainty with which it is applied will put a premium on accident-prevention work. This cost can be materially reduced by the installation of safety devices (Pascal M.Rapier and Andrew C.Klein,1998).Research experience has shown that approximately 80% of all the petrochemical industrial accidents are preventable. As far as the fire loss prevention is concerned, which is an indispensable element in petrochemical industry. It exists only with top management direction and the support of labor. The designation fire protection usually encompasses the entire field of prevention of loss by fire, including both the causes for the occurrence of fires and methods for minimizing their consequence. Some of the fire standards of protection to prevent injury and loss of life are given in this paper. Fire protection engineering practices both in building design and in safe operating practices are also included (Pascal M.Rapier and Andrew C.Klein,1998). Noise safety is concerned, noise is recognized as a pollutant, both as a nuisance and as the cause of hearing impairment. There is evidence in sites that noise cause ailment such as hearing impairment, physiological and psychological disorders including anxiety and heart disorders. Protection from noise is required when sound levels exceed those standards. When protective equipment is required, it must be provided by a trained person and periodic checks made of the effectiveness (Pascal M.Rapier and Andrew C.Klein,1998).

3.9 Total Quality Management (TQM)

Total Quality Management (TQM) can be broadly defined as a set of systematic activities carried by an institution to efficiently achieve institutional objectives that satisfies beneficiaries at the appropriate time and price. The definition of quality is "The totality of features and characteristics of products or services that bear on its ability, efficacy and values to satisfy a given or implied need". TQM is a comprehensive and structured approach to an educational integrated management that seeks to improve the quality of educational services through ongoing refinements in response to continuous feedback. Thus this standard definition of quality is applicable commonly to both products and services that is stated and unstated (Giri.,C.C. et.al.,2003).TQM has an important role to play in addressing quality issues surrounding the industrial development.TQM is a comprehensive and structured approach to petrochemical sector that seeks to improve the quality of services through ongoing refinements in response to continuous feedback . TQM and Total environment quality management (TEQM) leads to sustainable petrochemical development . International Organizational for Standardization's ISO 9000 series define TQM as a management approach centered on quality, based on the participation of all its members and aiming at long term success through customer satisfaction and benefits to all members of the organization and society. Hence, TQM is based on quality management from the customer's point of view. TQM processes are divided into four sequential categories: plan, do, check, and act (Figure-12). This is also called the *PDCA* cycle or *Deming's* cycle for continuous process improvement. In the *planning* phase, petrochemists define the problem to be addressed, collect relevant data, and ascertain the problem's root cause; in the *doing* phase, petrochemists lists develop and implement a solution, and decide upon a measurement to gauge its effectiveness and efficiency ; in the *checking* phase, petrochemists confirm the result through before-and–after data comparison; in the *acting* phase, petrochemists document their results, inform others about process changes, and make recommendations for the problem to be addresses in the next PDCA cycle. ISO 9000 series focus on quality management for all sorts of organizations. It defines the features of quality management system (QMS) and ISO 14000 Environmetnal Managementn System standards that need to be in place to ensure that identify and focus on improving the areas where they have significant deficiencies (Giri.,C.C. et.al.,2003).

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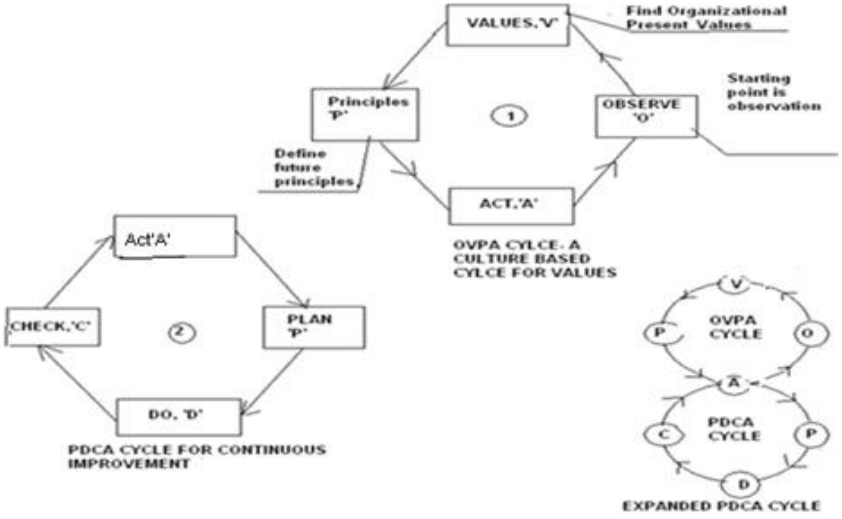

Figure- 12: Conceptualization of Culture Based Environmental and Quality Management entitled "OVPA" Cycle By Incorporating the Expanded PDCA Cycle for Indian Construction Industries towards Sustainable Construction Management

The ISO 14000 Environmental Management System (EMS) standards apply to the management system to manage an organization's environmental issues and opportunities (Giri.,C.C. et.al.,2003). It defines the features of an EMS that need to be in place to ensure that the organization identifies and focuses on improving areas where they have significant environmental impacts. This system has been integrated with ISO 9000 Quality Management System (QMS) standards in order to achieve excellence in quality as well as environmental obligations in midget electrode project. The overall aim of the EMS is to provide protection to the environment and to prevent pollution to manufacture eco-friendly products and services. The ISO 14000 series of standards assist the organizations to excel environmental and economic gains for continuously improving organizational performances. They are used for prevention of pollution, reduction in wastes, enhancement of internal management system efficiency, optimum utilization of resources and compliances for legal and regulatory requirements. EMS can be basically divided into five events which form the sequence of a cycle (Figure 13) . These five events are (1) Environmental Quality Policy, (2) Environmental Quality Planning, (3) Environmental Quality implementation and operations, (4) Checking and corrective actions, and (5) Management Review. The ISO 14000 series of standards have also been designed to cover the areas of environmental issues and opportunities for the organizations to compete the global customer centric markets so that the products and services can be manufactured at par with the international requirements (Giri.,C.C. et.al.,2003).

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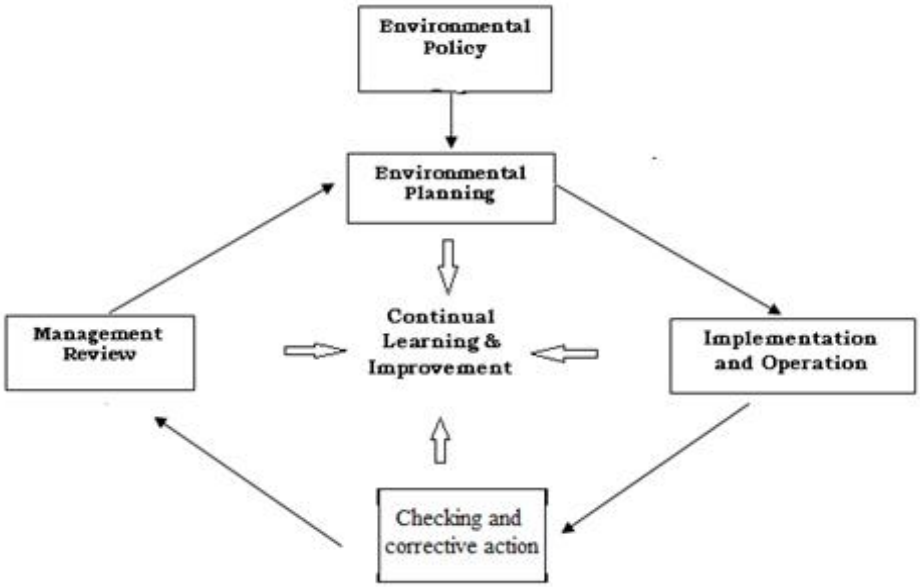

Figure - 13; Environmental Management System

EMS focuses on key drives of performance excellence in products and processes as well as organizations that are focused on delivering values to the customers, internal operational processes, and to staff's learning. It may be mentoned that Environment and Quality Management (EQM)is a managerial approach centered on environment and quality through beneficiary satisfaction in petrochemical industries that lead to economical improvement and sustainability (Vijayan Gurumurthy Iyer, 2016). Hence, this system approach to the environmental management shall achieve excellence in the overall performances of the organization**.**

4. Conclusions and recommendations

SEA process has been aimed in order to incorporate environmental quality and sustainability factors in to nulear project planning and decision-making process, such as project formulation and appraisal of Indo-Matsushita midget electrode (battery carbon rod) plant in 1979 at Tada, sustainable fertilizer project, green sustainable petrochemical process, resource conservation and recovery (RCR) in systems, nuclear power plant, China's Quinson Nuclear Power Plant, cotton roller ginning plant and concrete that included polices, programs, plans and legislative actions. The primary purpose of the SEA process is to encourage the consideration of the environment, safety, health, social and sustainability factors in organizational planning and decision making process and to arrive at actions that are compatible.EIA should be considered as an official tool to protect the environment. Sanitation impact assessment has been investigated for sanitary projects and plans. RCR and EHIA process is a multidisciplinary approach that must be necessary in providing a prevention mechanism for environmental quality management and protection in any nuclear power development case study conducted at China's Quinson Nuclear Power Plant. EIA process is designed to identify and predict the potential environmental effects of the physical, biological, ecological, socio-economical, cultural environment and on human health and well-being are adequately protected.

As per research results, process should include the integrated consideration of technical or engineering, economic, environmental, safety, health, social and sustainability factorsto achieve business excellence.The SEA process protocol has been proposed for checking the quality of environmental and social assessments and management plans. This treaty and official govenment procedures of SEA helpful for making much earlier in the decision-making process than RCR and EHIA processes. Therefore, it is key tool for sustainable development. SEA aims to incorporate environmental and sustainability considerations in to strategic decision- making processes, to formulate policies, plans, and programs and legislative actions. Prior to the National Environmental Policy Act (NEPA) process in 1970 in the USA, technical and economic factors dominance the World's projects. The ISO 14000 Environmental Management System standards apply to the management system concepts of total quality management to the management of an organization's environmental issues and opportunities.It defines the features of an EMS that need to be in place to ensure that organizations identify and focus on improving areas where they have significant environmental impacts. EMS focuses on key drives of performance excellence in products and processes as well as organizations that are focused on delivering values to the customers, internal operational processes, and to staff's learning. Hence, this system approach to the environmental management

shall achieve excellence in the overall organizational performance. Petrochemcial project environmental lifecycle analysis has been conduced for identifying and measuring the impact of petrochemical industrial products on the environmental quality means of mass and energy balance methods. Solid and hazardous management method has been devised LCA considers the petrochemical activities related to raw materials, transformation, ancillary materials, equipments, methods, market,production, use, disposal and ancillary equipment.

As far as the petrochemical environmental quality & safety is concerned, personal protective equipment and materials that include garments, clothing, gloves, safety shoes, hard hats, safety glasses, shields, respirators, full aprons, safety belts, and other safety items have to be used by nuclear power plant personnel especially at China's Quinson Nuclear Power Plant. Such equipment is important for personal protection and for safety. It is the manager's and supervisor's responsibility to ensure that they are used. The enactment of worker's compensation laws and occupational disease law shall increase materially to the cost of insurance to industry. The increased cost and the certainty with which it is applied will put a premium on disaster prevention work. This cost can be materially reduced by the installation of safety devices. RCR and EIA of petrochemical managerial research experience has shown that approximately 80% of all the petrochemical industrial disaster are preventable. It is concluded that environment coupled with quality management is a managerial approach centered on environment and quality through beneficiary satisfaction that leads to economical improvement and sustainability based on the triple bottom-line approach. TQM has an important role to play in addressing environmental quality issues surrounding the sustainable petrochemical industrial development. Sustainable water and waste water management has been discussed. Vijayan Gurumurthy Iyer (2022) mentioned that the root cause problem solution for ozone layer depletion potential (OLP) impact, global warming potential (GWP) impact and green house synergic (augmentative) gas (GHG) emission impact in context to petrochemical industrial plants are measured, monitored and mitigated by international environmental impact assessment process (Figure-3) for the sustainable environmental climate change and control.

RCR, EIA and EHIA processes have been conducted for a nuclear power plant China's Quinson Nuclear Power Plant to consider the safety and health impacts to mitigate psychological health loadings on Workers and nearby residents. SEA system is a potentially useful element of good environmental quality Management and sustainable development; however, as currently practiced in petrochemical industries, it is far from perfection. Emphasis should be given in nuclear power plant industries on maintaining Economic viability of the operation, while in turn taking care to preserve the ecological and social Sustainabilities of the country. International EIA process required multi-disciplinary approach that has been conducted very early stage of Indo-Matsushita carbon rod project in 1982 at Tada for economic, Environmental and social viabilities.

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