



# IIChE NEWSLETTER 2019

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## President's Corner



**Dear Members,**

After a gratifying year as the President of IIChE, it is time for me to take leave. I begin this column by conveying my greetings to all the Members of IIChE for a Happy New Year. Also, I send my compliments to the new Council of IIChE and the newly elected office bearers of the Institute. I wish every success to Prof. V.V. Basava Rao, who takes over the baton of Presidentship from me. During this one year, there were many challenges. Nevertheless, it was an enriching and fulfilling experience for me as the President of the Institute.

Very recently, we had the most important event of the IIChE calendar. We had an enlightening session of CHEMCON 2019 in New Delhi during 15 – 19 December 2019, organised by the Northern Regional Centre of IIChE and Department of Chemical Engineering, IIT, Delhi. It was inaugurated on 15 December 2019 by Shri Dharmendra Pradhan, Minister of Petroleum and Natural Gas and Ministry of Steel, Government of India in the presence of other distinguished guests. The central theme of CHEMCON 2019 was 'Advances in Chemical Engineering for Industrial Applications'. Characteristically, CHEMCON this year was packed with different events, such as, Memorial Lectures, CHEMCON Distinguished Speaker



Lectures, plenary lectures, Award ceremony, etc. The three most prestigious Lectures, i.e., Dr. H.L. Roy Memorial Lecture, Prof. N.R. Kamath Memorial Lecture and C.K. Murthy Memorial Lecture, were delivered respectively by Prof. K. VijayRaghavan, Principal Scientific Adviser to the Govt. of India; by Dr. S S V Ramakumar, Director, R&D, Indian Oil Corporation Ltd., Faridabad (Haryana); and by Prof. Ashutosh Sharma, Secretary, DST, Govt. of India & Institute Chair Professor, IIT Kanpur. Shri Dhirubhai Ambani Commemoration Lecture on 'Innovation for Economic Growth with Respect to Chemical Industries: Retrospect & Prospect' was delivered by Padma Vibhushan Prof. M.M. Sharma, globally renowned academic and chemical engineer. More than 400 delegates participated in the event.

This year, in a departure from the general practice, Shri Dhirubhai Ambani Commemoration Day was observed by IIChE as a separate programme on 28 and 29 December 2019 at Jaipur, which was organised by the Jaipur Regional Centre of IIChE. Programmes included the prestigious Shri Dhirubhai Ambani Oration Lecture, delivered by Padma Vibhushan Prof. M.M. Sharma. Several other Orations and Invited Lectures were delivered by renowned academics and industry bigwigs. An International Conference, titled, 'Energy & Environment: Challenges & Opportunities for Industries' was also held.

Earlier, on 17 and 18 October 2019, we also had a successful 15th Annual Session of Students' Chemical Engineering Congress, (SCHEMCON 2019) at Ankleshwar, Gujarat, organised by the Student Chapter of IIChE, Department of Chemical Engineering, Shroff S.R. Rotary Institute of Chemical Technology (SRICT) under the aegis of the Ankleshwar Regional Centre, IIChE. The Chief Guest of the event was Padma Vibhushan Prof M M Sharma. A total of 438 students attended the event from IITs, NITs, and other state universities and colleges. The objective of organising SCHEMCON has been to offer a suitable platform to the students of Chemical Engineering, where they would be able to showcase their innovative and creative ideas; while at the same time, they would get exposure to new insights into their subject from accomplished academics and industry personnel. Judging from the enthusiastic response from the students, which has been growing over the years, one can safely assume that this objective has been fairly successful. However, there is always a scope for improvement and further expansion of this platform to attract more students.

In fact, I have all along been emphasising the need for IIChE to concentrate on finding innovative means and meaningful strategies to attract the student community by providing meaningful guidance to them which would help shape their career. Over the years, several of the IIChE Student Chapters (164 at present) have been playing a positive role in this regard and reaching out to them by various means. Nevertheless, a more comprehensive drive by Regional Centres of IIChE involving all the Student Chapters under their wing would help evolve an inclusive and result-oriented template. Many of our Regional Centres have a rich pool of human resources, i.e., renowned academics and industry experts as their Members. Their knowledge and expertise would greatly contribute to a comprehensive skill enhancement programme for students.

In this context, I would also like to stress the need for larger publicity of IIChE's bouquet of awards and prizes that are given away during CHEMCON and SCHEMCON. A large number of National Awards and CHEMCON Distinguished Speaker Awards are conferred on widely respected and globally renowned scientists, academics, technocrats, entrepreneurs, etc., for recognising excellence, innovations and life-long contribution to the field of Chemical Engineering. Simultaneously, there are several other awards, which have been instituted to



encourage, support and inspire young talents – under-graduate, post-graduate students and research scholars – to pursue their academic excellence and research achievements. It is a matter of regret that we do not get adequate number of nominations for these awards from eligible candidates. A list of all the IIChE awards along with other necessary details is available on the IIChE website. I would request our Members to publicise about these awards, meant for young research scholars, students, professionals, etc. In fact, the Council has also been considering revising and widening the eligibility criteria for some of these awards so that there could be a larger number of prospective candidates. The process has already started.

The IIChE Members would agree that being a non-profit organisation, the Institute needs constant drive for resource generation so as to sustain its activities. As a matter of fact, in recent period, the Institute has been undergoing financially trying times due to a number of external factors largely beyond our control. It has, therefore, become important for the Institute to carve out new roles and explore new avenues for resource generation. One of the primary means for fund generation is undoubtedly enhancement of the Membership base. The onus to an extent falls on us – the Members of the Institute – to see that new Members, both Individual and Organisational, come into the IIChE fold. A concerted and collective effort will indeed usher in positive changes to this direction.

Even if my tenure as the IIChE President ends, I will remain closely involved with the Institute and its affairs. As the Past President, I will look forward to sharing my experience and offering my insights to take the Institute forward. My best wishes to you all. Thank you.

**S V Satyanarayana**

### OBITUARY

With profound grief, we announce the sad demise of our following Members:

**Prof. T.K. Ghose (LM 00095):** The late Prof. Ghose was a Member since 1951.

**Mr. Swaminathan (LM 000568):** The late Mr. Swaminathan was a Member since 1961.

**Mr. J. Das (LM 05594):** The late Mr. Das was a Member since 1979.

**Mr. K.C. Sadangi (LAM 03945):** The late Mr. Sadangi was a Member since 1974.

**Prof. S.L. Narayanamurthy (LM 00989):** The late Prof. Narayanamurthy was a Member since 1963.

We offer our heartfelt condolence to the bereaved families of our valued and departed Members.



## **Prof. P. Sen Gupta (1935 – 2020)**

Prof. P. Sen Gupta, who passed away on 30 January 2020 at the age of 85 years, became a Member of IIChE way back in January 1962. An academic throughout his professional life, he was associated with the Department of Chemical Engineering, IIT, Kharagpur, from where he retired as a Professor. Over the years, the late Prof. Sen Gupta had been involved with the Institute through thick and thin. At different periods of time, he was elected to the Council and made significant contributions while holding various posts. In 1988, the late Prof. Sen Gupta was elected the Hony. Secretary, and again in 1994, he was the Vice President of the Institute. In 1995 and 1996, he was the Honorary Editor for the Institute quarterly, *Indian Chemical Engineer*, followed by a tenure as the Hony. Secretary for a second time in the year 2000. Finally, in 2001 and 2002, he held the office of the Honorary Treasurer. He became Chairman of the Calcutta Regional Centre during 2002 – '03 and 2003 – '04.

Due to his advancing age, for the last few years, the late Prof. Sen Gupta was not so closely in touch with the Institute. Nonetheless, he remained a guardian figure – always keen on the IIChE affairs and wellbeing of the Headquarters staff members. As a matter of fact, with each of them, he had a personal rapport. As a token of his affection and concern for the staff members, in 2002, Prof. Sen Gupta created an endowment and introduced an annual award, namely, 'Prof..P. Sen Gupta Award for Best Employee of the Year', which is given away annually at CHEMCON. He also donated a large number of text books on Chemical Engineering over a period of time to the Institute Library at the Headquarters in Kolkata. In recognition of his contribution to the Institute over the decades, the Calcutta Regional Centre felicitated Prof. Sen Gupta in 2009.

Prof. P. Sen Gupta will be fondly remembered by all who came in touch with him. His genuine commitment to the wellbeing of the Institute would be valued for years to come. We convey our heartfelt condolence to the extended family of the late Prof. P. Sen Gupta.



## **Prof. Sunit Mukherjee (1931 – 2020)**

Prof. Sunit Mukherjee, who we lost on 4 January 2020, will be remembered in the same breath with Dr. Subhash Mukherjee, the creator of India's first test tube baby. A Member of IIChE since 1958, the late Prof. Mukherjee was a cryobiologist by profession and former Head, Department of Food Technology, Jadavpur University, Kolkata. However, more importantly, the late Prof. Sunit Mukherjee was an inseparable part of the two-member team along with the late Dr. Subhash Mukherjee, who pioneered the in-vitro fertilization (IVF) in India through a home-grown technology. Tragically as due recognition eluded Dr. Subhash Mukherjee in his life time, Prof. Sunit Mukherjee too remained in obscurity. However, that never dampened Prof. Mukherjee's scientific spirit and it was through his untiring effort and endeavour that finally Dr. Subhash Mukherjee got recognition for his path-breaking work.

Till almost the end of his life, the late Prof. Sunit Mukherjee made it a point to attend major IIChE events in Kolkata, whether organised by the Headquarters or the Calcutta Regional Centre. All those who came to know him personally became his admirer, not only for his untiring work or indomitable spirit but also for his pleasant personality, charm and grace.

### **Achievement**

We are happy to share with our Members the news of **Mr. Anirban Ghosh**, Junior Assistant, IIChE HQ office, who has recently passed the Final Examination of the Institute of Chartered Accountants of India. Mr. Ghosh is now qualified as a Chartered Accountant.

We congratulate Mr. Ghosh for his achievement and wish him even greater professional success in life.



## R&D Note

Here is a thumb rule to estimate a typical maximum value of Cv of a control valve (equal to or larger than 1 inch).

(The valve coefficient or the flow coefficient or Cv of a control valve is a universal capacity index. It is defined as “the number of US gallons of water per minute at 60<sup>0</sup> F that will flow through a valve with a pressure drop of one psi).

A typical maximum value of Cv is approximately given by the empirical equation  $Cv = 10 \times \text{square of the valve size in inches}$ .

Accordingly,

Size of Control Valve, inches	1	1½	2	2 ½	3	4	5	6	8	10	12	14
Maximum value of Cv 10 x (valve size, inches) <sup>2</sup>	10	22.5	40	62.5	90	160	250	360	640	1000	1440	1960

This is applicable irrespective of the type of control valve (linear/ equal %).

This almost tallies with the typical maximum values of Cv given by various manufacturers of control valves.

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## Process Safety and Risk Management V

### Investigation of Process Safety Incidents

Joy M Shah



*“For a long time, people were saying that most accidents were due to human error. This is true, but in a sense, it is not helpful..It is like saying that falls are due to gravity.” – Dr. Travor Kletz*

**Incident investigation** is the second buzz word in Process Safety Management. Incident is any event that could have resulted or did result in injury or illness, property damage, environmental release, business interruption or adverse community reaction. The event that could have resulted but actually not resulted in above mentioned loss is Near Miss and incident which have resulted in to above mentioned loss is called Accident.

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There are three phases of process related incidents. Viz.:

1. Change from normal operating state into state of abnormal operation, i.e. deviation from intended safe operation.
2. Loss of control of abnormal operating phase, which may involve break down of barrier function and lead to incident.
3. Release of energies in the form of chemical, mechanical, electrical, pressure or thermal due to loss of control and adverse impact on Human, Assets or environment.

It is essential that all Process Safety Incidents are reported and investigated thoroughly to prevent its recurrence & to continuously improve overall performance. **Benefits of investigation are as follows:**

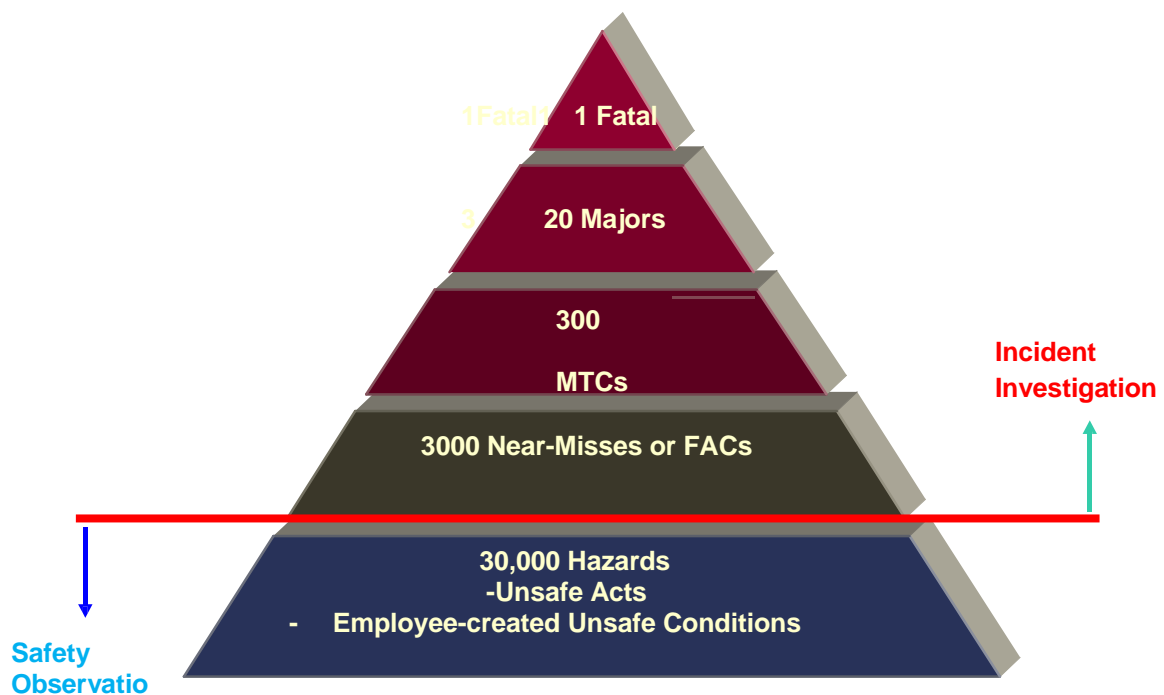
1. Identification of root cause, corrective action and training to workman will avoid repeat of incident.
2. It is demonstration of commitment to safety and increases confidence of workmen.
3. It helps to spot deficiencies in safety system and help to improve policies, guidelines and standards.
4. It promotes an environment of openness, learning from each other, and improve communication.

**Line manager** is beneficiary of Incident investigation, therefore is responsible for



It is estimated that 96% of incident is occurring due to unsafe act and only 4% unsafe conditions.

M/s Dupont have defined **Hazards Pyramid** as follows for easy understanding of where incident investigation is required. It indicates that any near miss or accident must be investigated.



### Process of Incidence Investigation

Incident investigation is an eight-step process, viz:

- 1) Make initial response and report the incident which includes coordinate emergency, preserve incident scene, preserve relevant evidence and document, brief report to the management, including classification of incidents for taking decision.
  - a) **Classification of an incident** is the most important activity as it helps to determine significance of incidents, with whom to communicate, what level of team would be required for an investigation as well as it helps in trending and other analytics. Incidents can be classified in to four areas, viz. Process, Fire, Environment and Distribution. For each area, it is further classified in A, B and C categories. A Category refers to the highest severity incidents.





b) Following are the **criteria used for classification of incident**. For each criteria, levels and marks are defined and cut off marks for category A,B and C are decided based on risk tolerance of an organization.

- |   |   |
|---|---|
| <ul style="list-style-type: none"><li>i. Hazards &amp; Materials involved - Type of event and material released (flammability, combustibility, toxicity)</li><li>ii. Actual quantity (size) of release.</li><li>iii. System inventory with Potential quantity (size) of release.</li><li>iv. Degree of control by site during incident.</li><li>v. Involvement and functionality of lines of defence /layers of protection.</li></ul> | <ul style="list-style-type: none"><li>vi. Actual on-site impact (injuries, emergency response, evacuation).</li><li>vii. Potential on-site impact.</li><li>viii. Actual off-site impact (injuries, shelter in place, agency reporting, media attention).</li><li>ix. Potential off-site impact.</li><li>x. Actual monetary loss in equipment damage and last revenue.</li></ul> |
|---|---|

2) Site Management to form team for incident investigation based on classification which Team leader, line manager, line manager, safety personnel, technology, maintenance, operation engineers and relevant specialist as well as union representative. Team leader is responsible to conduct comprehensive and timely investigation, call and preside over meeting, ensure participation of team members, keep investigation focused for prompt and complete results and report to management.

3) Team leader will assess the additional technical resource requirement and engage them. Team will assess Physical, Human and Systems evidences from relevant technical information, its location, deviation from normal operating practice, list of details of injury, exposure and damage list and interview witnesses, take pictures video and other evidences etc., as well as carry out hazards analysis and differentiate between opinion and facts. Team to determine and organize facts in chronological orders on time line for further investigation.



**4)** After organizing facts team to analyse and identify key factors (Probable Root cause). Key factors are defined as circumstances that contributed to or may reasonably believe to have contributed to the incident occurrence even though a clear causal connection may not be found. These circumstances include human, equipment and /or operating / managing systems that are found to be deficient or otherwise capable of being improved.

a) There are several methods for determination of key factors or root cause failure analysis as given below. Team leader to select right method for the incident investigation.

i. Traditional by listing all causes and elimination of probability (EOP). This is normally informal and one to one.

ii. Brainstorming – This is team activity but not structured.

iii. What – if analysis – This is slightly more structured brain storming tool where cause and effects are established.

iv. Why - Why analysis or logic tree analysis (WWA) – This is more structured, easy to follow tool and is described in the following paragraph.

v. Fault tree analysis (FTA) – It is very structured and graphic model starting from undesired events which display various combination of failure and drilled down to root cause.

vi. Causal factor charting (CFT) – This is more user-friendly version of FTA but rely on expertise of the group. Causal factors are the occurrences and actions that made major contribution to the incident.

vii. Management oversight risk tree (MORT) – It is also based on fault tree analysis logic but represent the predefined trees.

b) Once probable root causes are identified, verify hypothesis by facts and convert it to key factors.

**5)** After verifying hypothesis, determine the system to be strengthened. This can be related to improvement in technology, upgradation of operation and maintenance practices, improving compliance to organization and management system as well as upgrading the management system in critical areas, including, capability development and audits.

**6)** The major outcome of fifth step is divided into minor action plan with responsibilities and mutually agreed target dates. These are recommended corrective and preventive actions. It results in to greatest positive effect when performed in atmosphere of openness and trust.



7) Document the report and get commitment of line management to implement its corrective and preventive actions. Also communicate the findings in form of “Learning from Incident” (LFI) to all relevant people. LFI is summary of what happened and what action is required to prevent occurrence of incidents in the same and similar area.

8) Periodic followup by Management and Team leader to ensure that all action is completed and LFI is communicated to relevant people to avoid recurrence.

### **Why – Why analysis or developing Why tree:**

Why-why analysis is commonly used method for RCFA. . It is systematic and disciplined approach to uncover key factors through identification of three factors:

- 1) Physical causes which is apparent from observation,
- 2) Human causes which include intentional and unintentional behaviours mistakes, lake of awareness and knowledge as well as failing to act,
- 3) System cause, related to communication, procedures, training, documentation policies, standard of performance, etc.

It is called Why tree as we are asking “WHY?” to get the key factors. It is powerful logic of cause and effect. It is conducted by picking up any abnormal observation and asking Why several times. First two why can lead us to physical key factors, another two why to each physical factor can lead to Human factors. Asking why to human factor can identify systemic key factors for the incidents. Same process to be repeated for all abnormal observations or all significant event.

For every hypothesis identified using Why Tree, verification is important to convert it to key factor.

### **Tips for building good Why Tree:**

- 1) Base all causes and effect on facts. Do not use someone’s subjective belief as objective FACTS. Conventional wisdom can mislead.
- 2) Cause and effect statement should be clear and should contain a subject and a verb as a minimum.
- 3) Cause and effect to have logical relationship to ensure it is true.

- 3) Cause and effect to be tangible and observable. If required, use shorter steps.
- 4) Cause should be enough to create effect. If more than one cause is required, define correctly.
- 5) Continue asking Why till we find point where we no longer have control or influence over the solutions.



### **Role of Management in Incident Investigation process:**

Management practices play a very vital role for successful incident investigation as given below:

- \*Ensure that all incidents are reported by employees, contractor as well as third parties.
- \*Establish systems and procedures for incident investigation.
- \*Lead by example and communicate value of conducting incident investigation.
- \*Define right priority to investigation and provide resources.
- \*Implement and follow up system to prevent recurrence.
- \*Ensure that communication and learning from incidents reach to relevant people.
- \*Last but not the most important is to create an atmosphere of trust and openness such that everyone participates in identification of root cause and implement recommendations.

### **Guideline for Incident Investigation team staffing and role of departmental position:**

Incident Investigation is conducted by a team of Technical Expert, Maintenance Expert, Safety Expert as well as Operation Expert. Design engineer will help team to understand cause of failure. One of the Operation or Technical expert is expected to work for the same or similar technology for at least 10 years. Team is facilitated and led by a senior person who is trained in Investigation methodology as well as various Investigation procedures. Investigation team leader/facilitator can associate the required expertise and specialist as and when required. Incident Investigation is team work and each one needs to participate in this activity.

Roles and responsibility of each position of departments are as follows:

#### **Head of Department:**

- \*Encourage reporting of Process safety incidents and near misses.
- \*Ensure proper and timely investigations.
- \*Involve subject matter experts from other plants / sites / organizations in investigations.
- \*Participate in investigation of process safety incidents, esp., Class A and B.
- \*Ensure quality and compliance of the recommendations (Review and refine it and assign responsibilities and timelines).
- \*Identify relevant learning from incidents at other places and ensure implementation.



### **Sectional head of the Department:**

- \*Encourage reporting of process safety incidents and near misses.
- \*Participate in incident investigation.
- \*Ensure compliance of recommendations.
- \*Identify relevant learning from incidents at other places and ensure implementation proactively.
- \*Ensure that learnings from incidents are shared with all employees.

### **Managers and Supervisors:**

- \*Report incidents and near misses promptly.
- \*Motivate sub-ordinates for reporting all incidents and near misses.
- \*Participate in incident investigation.
- \*Implement recommendations of investigations.
- \*Implement (proactively) relevant learnings from incidents at other places.
- \*Share the learning from incidents to all employees.

### **Executives and Operators:**

- \*Report all the incidents promptly.
- \*Understand and report the near misses, i.e., Blocked PSV outlets, Interlock found by pass condition, \*PSV popping, PSV spring found in broken condition during overhauling, safety operation limit violation, etc.
- \*Follow the learning from incidents and near misses.
- \*Discuss and share LFI with contractor workers.
- \*Comply with the recommendations.

**In conclusion, the purpose of incident investigation should be finding facts not faults. Companies have no memory. Systematic investigation and learning from incidents can help avoid repeat incidents and improve safety performance.**

### **References:**

1. 2<sup>nd</sup> and 3<sup>rd</sup> edition guideline for Investigating Process Safety Incidents by M/s CCPS.
2. Training for Improving safety through Incident Investigation by M/s DuPont.



## Spotlight

### Time to Relook into Three-Stage Nuclear Power Programme

T L Prasad



The author is a Faculty Member at Homi Bhabha National Institute, Mumbai

Nuclear power remains the only large-scale technology that can continuously provide electricity with low 'Green House Gas' emissions. The countries, aspiring for energy mix with nuclear options, either follow 'Open Nuclear Fuel Cycle' or 'Closed Nuclear Fuel Cycle'. Uranium is the most critical ingredient for the production of nuclear power using either of the options of Nuclear Fuel Cycles. The majority of the world's current nuclear capacity utilises Light Water Reactors (LWRs) in which the fuel is used once and then stored for disposal (Open Nuclear Fuel cycle). This consumes uranium at a rate of around 180 tonne per 1 GWe reactor per year. However, other systems, such as, Fast Breeder Reactors, recycle their fuel in a Closed Nuclear Fuel Cycle and are able to generate a factor of over 60 times more energy from uranium. To make Nuclear power sustainable and to meet the policy requirements, various strategies have been conceived and adopted by different countries throughout the world during formative stages of Nuclear power programme.

Three-stage Nuclear power programme concept is one such option which is being adopted. It entails utilisation of fissile and fertile nuclear fuels in different sequence and combinations, achieving the required milestones in particular time scales. Countries with moderate uranium deposits and vast thorium deposits adopted 3-Stage nuclear programme. The three-stage programme requires linking of:

- (1) Pressurised Heavy Water Reactor (PHWR) using natural nuclear fuel (U-238 – U-235).
- (2) Fast Breeder Reactor (FBR) using nuclear fuel (U-238 – Pu-239) and Th-232 – U-233/ Pu-239 based self sustain breeder.
- (3) Advanced Heavy Water Reactor (AHWR) using (Th, U-233) O<sub>2</sub> and (Th, Pu) O<sub>2</sub> fuels

In this article, the possible reasons are being discussed leading to the need for a relook into the prospective of 'Three-stage nuclear power programme'.

#### Reason 1 – LPG (Liberalisation, Privatisation, Globalisation) era

India has been importing natural uranium since 2009 which has paved the way for expansion of the PHWR fleet. Likewise, India should negotiate the import of plutonium for rapidly expanding the country's FBR programme. The impeccable safeguard records of India should make this possible. The US-Russia 'megaton to megawatt' model should be followed for this.



In this era of liberalisation, privatisation and globalisation, various business models are opening up for the countries. Indo-US nuclear deal (agreement signed during the year 2008) is one of the managerial aspects which needs a relook into along with continuation of the first stage programme for meeting energy requirements. Reduction in energy requirements per capita is being noticed in some of the developed countries. There is an ambitious target of achieving 10-fold rise in production of uranium by the year 2030 for partial fulfilment of the fuel requirement of India. This needs multi-pronged approach like augmentation of capacities of the existing mines and mills as well as opening up of new resources along with processing facilities. Other advantages of nuclear energy are that the uranium producers are considered to be more reliable as suppliers than some of the oil and gas producing countries. Moreover, the uranium fuel price is only a small share of the “kWh production price”.

### **Reason 2 - Time scales for technology maturity**

In order to mitigate emissions of carbon dioxide and other greenhouse gases, massive investment into new energy technologies will be needed. In effect, there has to be a complete transformation of the energy system over the coming decades. One of the central results from research on transformative, deep decarbonisation of the energy system is that a diverse portfolio of options will lower risks and costs. Eliminating options could raise costs substantially; indeed, some research has focused on the consequences of removing nuclear power as an option, because this technology in particular suffers from negative public perception in markets where it has attained its largest penetrations, such as, the US, Western Europe, and Japan. Due to these political problems as serious and prohibit new nuclear deployments altogether—often necessitating dramatic shifts to renewable energy systems. The contribution of hydropower and renewable energy sources continued to increase significantly, reaching 25.8% in 2018, while the share of nuclear electricity production remained at about 10.2% of the total electricity production. The renewable energy based systems are matching with technology maturity and time scales.

### **Reason 3 - Spent fuel and reprocessing aspects**

In France and the UK, the closed fuel cycle has already been demonstrated on industrial scale by removing the long-lived waste, the plutonium isotopes and other minor actinides, thus, shortening the time of radioactivity of the waste from several 100, 000 years to a few hundred years. In this manner, plutonium and other minor actinides are partitioned from the rest of the waste and then recycled in the reactors with fast neutron spectra, where they are destroyed by the fission process in order to produce energy. This mixture of actinides is not suitable for bomb manufacture and in this way safer burning and production of energy may be accomplished. Alternatively, the actinides or a portion of them could be brought into an accelerator-driven transmutation plant. Evidently, the waste handling in future reactors will be an important item for future research and its solution will largely determine how the waste from current reactors is managed.





It is necessary to solve problems with spent nuclear fuel and potential lack of fuel for the rising number of new power plants. Since the 1950s, there have been different concepts of using Accelerator Driven Systems (ADSs). With the ADSs, it is possible to sort out these problems. They can be used in three different operating modes. The first option is to use ADS to reduce the amount of spent nuclear fuel. The second is clear power usage as classic nuclear reactor with the difference that ADS works with a subcritical core. The third option is to use ADS to produce new fuel from fertile material via irradiation of this material in a secondary neutron field. These neutrons are produced in spallation reaction in the target material.

With reprocessing and recycling, energy potential is enhanced several folds. Even our modest uranium resources represent an energy source larger than coal deposits. Reprocessing and recycling also enable use of Thorium, which is abundant in a few countries.

#### **Reason 4 - Secondary sources of nuclear fuel**

To make nuclear power sustainable and economically viable, sources of uranium beyond the terrestrial ores are being developed. Uranium is the main fuel used in nuclear industry, which is widely distributed in nature. With the gradual development of nuclear power industry, the IAEA (International Atomic Energy Agency) expects that the world reactor-related uranium requirement will reach 104.74 thousand tU/yr by 2035. Due to shortage of terrestrially mined uranium, presently attention is focussed on unconventional uranium resources, such as, salt lake brine, seawater, etc. According to the regulations of the World Health Organization, the content of uranium in drinking-water must not exceed 14.4  $\mu\text{g/L}$ , and the uranium concentration in wastewater generated during uranium mining can reach 5 mg/L.

Countries like India with limited uranium resources have started exploring alternative sources to extract uranium. A lot of research is going on all over the world in this regard as indicated by a scientometric study that has been conducted to collect information on the international R&D activities for the recovery of uranium from secondary sources. A total of around 4,520 publications, that were published during 1972–2011, have been referred to. One of the biggest influences in this study is the approximately 4 billion tonnes of naturally occurring uranium, present in solution in seawater. The CRUDE (Coupling of Recovery of Uranium and other technology metals from Desalination Effluents) concept, being demonstrated, will help further. The countries, having short supply of indigenous primary resources, have been recommended to put more developmental efforts for the next level of demonstration of lab-based process technologies.



### **Reason 5 - Maturity in special fuel material processing technologies**

The data of International Atomic Energy Association (IAEA) reveals that Light Water Reactors are very dominant and has the capacity of 89%, followed by 6% PHWRs. Among Light Water Reactors (LWRs), the Pressurised Water Reactor (PWR) is the most preferred (82%) which has burn up of 45 GWd/tHM. India has also started work on PWR and developed capability in compact PWR for nuclear submarine program. The fuel for these reactors will be special fuel materials. During 1950 –'60s, technology for uranium upgrade was available with only selective countries. No direct role of upgraded uranium was envisaged when three-stage nuclear power programme was conceptualised. There was the problem of limited resources also. Nowadays, with the development and maturing of upgraded technology, long term planning for production of special fuels are under progress to cater to the needs of PWR and IPWR. Availability of domestic upgraded uranium can bring a paradigm shift in nuclear power programmes. Special fuel can play multiple roles in nuclear power programme.

Interest in nuclear power remains strong in many regions, particularly in the developing world. Commitments agreed under the Paris Agreement and other initiatives have the potential to support nuclear energy development. Addressing global warming requires a rapid transformation of how we produce and consume energy. Rising seas, damaging extreme weather events, severe ecological disruption, and the related toll on public health and the economy — all these impacts of climate change demand that we consider all possible options for limiting heat-trapping emissions, including, consideration of the respective costs and timelines for implementation of each option.

*Views expressed in this article are that of the author himself.*



## REGIONAL CENTRE ACTIVITIES

### AMARAVATI REGIONAL CENTRE

The **131<sup>st</sup> Birth Anniversary of Dr. H. L. Roy**, the founder President of IIChE, was celebrated at the R V R & J C College of Engineering on **2 November 2019**.

A **Seminar on 'Industrial Hazards and Safety'** was organised in association with the Andhra Sugars Limited, Tanuku on **30 November 2019**. It was inaugurated by Dr. A. Koshy, Director, RiskChem Engineering and Academy, Chennai.

Speakers at the seminar included **Prof. M. Venkateswara Rao**, Dept. of Chemical Engineering, and Dean, Examinations, RVR & JC College of Engineering (A), Guntur, explaining importance of the Topic of the seminar, '**Industrial Hazards and Safety**'. **Dr. A. Koshy**, speaking on '**Occupational Hazards and Process Safety**' and **Dr.G.S.Venkataratnam**, Senior Principal Scientist (Retd.) and Hony. Treasurer, IIChE, (2019), speaking on '**Safety - Is it a Value or Cost?**'

An interactive session was held at the end before Prof. M.V. Rao offered vote of thanks to the speakers and participants.



### ANKLESHWAR REGIONAL CENTRE

**Industry visit** to GNFC Ltd. plant, was arranged for the students of Chemical Engineering, SVMIT, Bharuch College on **21 September 2019**.

A **Talk** on '**New Developments and behaviour monitoring in Cooling Towers**' was presented by personnel of Msquare Engineers on **4 October 2019**.

### Coming Events

A **Seminar** on **20 January 2020** is planned on '**Troubleshooting in Chemical Industries - A Practical Approach**'



## ANNAMALAI REGIONAL CENTRE

A **Health Care Programme** was organised on **14 November 2019** for the IIChEMembers and students of the Faculty of Engineering and Technology (FEAT), Annamalai University. '**Nilavembu Kudineer**' was distributed on the occasion. The programme was inaugurated by Prof. K. Raghukandan, Dean, FEAT, Annamalai University.



A **Faculty Development Programme** on '**Soft Skill Training**' was conducted by **Mr.D.Manivannan** (Alumni of 1981 Chemical Engineering Batch, Annamalai University.) on **18 November 2019**. This programme was organised by the Annamalai RC for the IIChEMembers, Department of Chemical Engineering, Annamalai University.

### Coming Events

An **Internship programme** on proper operation of the wastewater treatment plants for Student Members of **IIChE** has been planned, to be held in **January 2020**. It will be conducted by Mr. S. P. Lakshmanaan Director, Clar Aqua (P) Ltd., Chennai.

A lecture by **Mr.R.Karthikeyan**, Senior Manager, Atos India, Chennai is planned on '**Excellence in You**' in **January 2020**.

A **Training Programme** on '**Energy Management and Auditing**', to be conducted by **Mr.B.Senthil Kumar**, Director, NIN Energy Private Ltd., Chennai, is planned in **February 2020**.

A **lecture** is planned on '**Paints and Surface Coatings**' by **Mr. R. Stalin**, Senior Manager, KTC, Chennai in **February 2020**.

A **Lecture** is planned on '**Environmental Bioremediation**' by **Dr. N. Selvaraju**, Assistant Professor in Department of Biosciences and Bioengineering, IIT Guwahati in **March 2020**.



### BARODA REGIONAL CENTRE

A **Seminar** was held on **30 November 2019** on ‘**Developments in Pump Design and Applications**’.

The topics covered were basics of pumps, selection of right pump and drivers, new design features, different types of pumps, different types of pump applications, operational and maintenance aspects of pumps, case studies, etc.



### CHENNAI REGIONAL CENTRE

The **First Endowment Lecture in Memory of the Late Shri P.N.Devarajan** was delivered by Mr. K. Pandiyarajan, Minister for Tamil Official Language & Tamil Cultural, Tamil Nadu on **30 November 2019**.

### KHARAGPUR REGIONAL CENTRE

#### Coming Event:

The **3<sup>rd</sup> Bharat Ratna Dr. A P J Abdul Kalam Memorial Lecture** will be organised by the Kharagpur RC and the Department of Chemical Engineering, IIT Kharagpur on **8 January 2020**. Speaker: **Prof. Warren D Seider**. Topic: **Process Intensification of Algae Oil: Extraction to Biodiesel and Omega-3 Fatty Acids**.

### LUCKNOW REGIONAL CENTRE

A **Workshop** was held on ‘**Advances in Renewable and Bioenergy (ARB-2019)**’ under TEQIP-III during **19 – 23 October 2019**.

Areas covered in the workshop included Sustainable Energy Aspects, Parameters for Energy Crisis, Renewable and Non-renewable Energy Sources and their Impact on Energy Scenario, Energy and Environmental Aspects in Refineries, Solar Thermal Applications, Advances in Green Chemistry & Green Technology, Bioremediation and Waste Water Engineering, etc.



## PONDICHERRY REGIONAL CENTRE

**ACES Guest Lecture** was delivered on **20 September 2019** by **Mr R.Kadamban** Asst General Manager , Solara Active Pharma Sciences, Puducherry.

A **Talk with Demonstration** on the '**Importance of Communication**' was presented by **Prof. G.Srinivasan**, Head, Dept. of Chemical Engineering, Pondicherry Engineering College on **24 September 2019**.

**Industry visit** to Thilak industries, Kochin was organised on **25 September 2019**.

## PUNE REGIONAL CENTRE

### Coming Event:

**E-Disha 2020**, a **Symposium**, will be organised on **17 February 2020**. To be held in collaboration with CSIR-National Chemical Laboratory, Pune and Equinox, Pune, the meet will highlight various aspects of computer programs, artificial intelligence, software on improved chemical processes, etc.

## STUDENT CHAPTER ACTIVITIES

### ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY & SCIENCES, VISAKHAPATNAM

The Student Chapter was inaugurated on **28 September 2019** at the Institute by **Dr. A. Srinivas Kumar**, President, IIChE Waltair Regional Centre.



### CALCUTTA INSTITUTE OF TECHNOLOGY, KOLKATA

A **Seminar** was organised on '**Environmental Pollution Abatement and Safety in Chemical Industries**' on **12 November 2019**. **Mr. Malay K. Dutta**, former Director, OISD and **Dr. Prasun Chatterjee**, Director, WIST Water Solutions Pvt. Ltd. delivered lectures on the respective topic of '**Safety and Case Studies in Oil Refinery**' and '**Environmental Pollution Abatement: Concept and Applications with Reference to Thermal Power Plant and Integrated Steel Plant**'.





## PANDIT DEENDAYAL PETROLEUM UNIVERSITY, GANDHINAGAR

A **Lecture** was delivered on ‘**Computational Exploration from Molecular Systems to Solid Surfaces for Different Applications**’ on **16 September 2019**. It was delivered by **Dr. Biswajit Ganguly**, Sr. Principle Scientist, CSMCRI, Bhavnagar.

An interactive **Workshop** on ‘**Computer Aided Process Equipment Design**’ was held on **10 October 2019**. The session was conducted by an expert team from Reliance Industries Ltd., Vadodara.

**Chemfuge- 2019** was held on **15 November 2019**. It was an event of Inter College Chemical Engineering Quiz and Poster Competition.



## DELHI TECHNOLOGICAL UNIVERSITY, NEW DELHI

A **tree plantation drive** was undertaken in the University campus on **23 September 2019**, in which faculty students, faculty members and staff members took part. The drive was primarily led by senior Members of Northern Regional Centre, IChE.

The **International Year of Periodic Table** was celebrated on **23 October 2019**. On the occasion, a fun event, 'Periodic Quest' was organised for the students, in which a large number of students took part enthusiastically. The event was graced by a few senior faculty members.







## INSTITUTE OF ENGINEERING & TECHNOLOGY, LUCKNOW

**Alchemy-2019** was held, which included technical and sports events.

## NANDHA ENGINEERING COLLEGE, ERODE

**IICChE Student Chapter** was inaugurated on **1 September 2019**. Afterwards, a Lecture was delivered by **Mr. A.T. Sakthivel** Production Supervisor-offshore wells, Dubai Petroleum - United Arab Emirates on '**Oil Field Overview & H<sub>2</sub>S Safety**'.



Two **Seminars** were organised on **16 November 2019** and **29 November 2019**. The first one was on '**Green Chemistry and its Relevance to Society**' and the second one was on '**Recent Trends in Electro Chemical Applications**'. Dr. Kogularasu Sakthivel, Postdoctoral Research Faculty, National Cheng Kung University-Taiwan, was the Resource Person for the second seminar.

**Industry Visit** to Common Effluent Treatment Plant, Perundurai on **14 September 2019**.

## SASTRA, THANJAVUR

**Engineer's Day** was celebrated on **24 September 2019**. The Chief Guest of the evening was Dr. R. S. Saravanan, DST-Inspire Faculty Fellow, DST School of Chemical and Biotechnology, SASTRA.

The 7<sup>th</sup> edition of **Conference** on Advances in Process Engineering (CAPE) was held on **12, 13 October 2019**.

Prof. Abhijith P Deshpande, Department of Chemical Engineering, IIT Madras was the Chief Guest for the day. He also delivered the Plenary Lecture based on the topic '**Optimizing Microstructure for Products and Processing**'. On the second day, Mr. S.V.R. Krishnan, Executive Director-Operations, Tamil Nadu Paper Ltd., spoke on a number of diverse issues related to Instrumentation, the need to keep updated about the technology being used in industries, the need for chemical engineering students to choose core chemical industries, etc. Oral and poster presentations, Quizz Contest, etc., followed the lecture. Prizes were also given away.





## SRM INSTITUTE OF SCIENCE TECHNOLOGY, KANCHEEPURAM

**Chemflux, 2019**, a national level Students' Conference, was organised on **10, 11 October 2019**.



**Talks** were delivered, respectively, on 'Chemical Engineers Today and Life after Campus' by Ms. **Sreemanta Chakraborty**, Research Associate, HASETRI - JK TYRE R&D, Mysore, Karnataka on **13 September 2019**, on 'Overview of Petroleum Refinery and Opportunities for Chemical Engineers' by Mr. **S. Madasamy**, Industry, Deputy General Manager, CPCL, Chennai on **19 September 2019**, on 'Chemical Engineering: Beyond Class Room Learning' by Ms. **Gayathri**, Technician - Definitions & Methods, Michelin India, Tamilnadu Tyres Pvt. Ltd. on **1 December 2019** and on 'Fuel Cell Technology and Applications' by Dr. **M. Volga**, Research Institute, SRF, CEERI, Chennai on **4 December 2019**.

## VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY, NAGPUR

**Industry visit to Dinshaw's Dairy Factory and Ice-Cream plant** was organised on **28 September 2019** for the 2<sup>nd</sup> year Student Members of the Dept. of Chemical Engineering.



## GOVERNMENT ENGINEERING COLLEGE, TRISSUR

New functionaries of the Student Chapter took over their charge on **3 October 2019** in presence of Mr. Koya Venkata Reddy, Hony Secretary, Kochi RC. A **talk** was presented on Design Aspects of Chemical Engineering

## ST GITTS ENGINEERING COLLEGE, KOTTAYAM

On **26 October 2019**, a **Workshop** on 'Fire & Safety' was conducted. Mr. Koya Venkata Reddy, DGM (Process)-FEDO, FACT and Mr. Abhijith Narayanan, Manager(Safety), FACT were the Resource Persons.



## Upcoming Events

### **International Conference on Polymer Chemistry (ICPOLC-20)**

Date: 1, 2 March 2020  
Venue: Vijaywada, India  
Organiser: SAIRAP-South Asia  
Email: teamsairap.org

### **6<sup>th</sup> International Conference on Advances in Chemical Engineering & Technology**

Date: 2,3 March 2020  
Venue: London, UK  
Email: contact@conferenceseries.com

### **International Conference on Nanotechnology**

Date: 2 May 2020  
Venue: Cochin, India  
Organiser: ITAR-India  
Email: info@itar.in

### **Global Chemical Application Conference in Oil & Gas Industries (GCAC 2020 )**

Date: 29, 30 May 2020  
Venue: Mumbai, India  
Email: jyoti@confergoevents.com  
Website : <http://www.gcac.co.in>

### **8<sup>th</sup> World Summit on Chemical Engineering and Catalysis**

Date: 15, 16 July 2020  
Venue: Vienna, Austria  
Email:  
[chemicalengineering@europeannualconference.com](mailto:chemicalengineering@europeannualconference.com)

### **15<sup>th</sup> World Congress on Wind & Renewable Energy, 2020**

Date: 22, 23 July 2020  
Venue: Rome, Italy  
Email: [windenergy@scimedconference.com](mailto:windenergy@scimedconference.com)  
Phone: 1800 – 014 - 8923

- **SCHEMCON 2020** will be held on **11 and 12 September 2020** at **Perundurai**, to be organised by the IChE Students Chapter, Dept. of Chemical Engineering, **Kongu Engineering College**, Perundurai, Tamil Nadu. **Email:** [schemcon2020@gmail.com](mailto:schemcon2020@gmail.com)
- **CHEMCON 2020** will be held during **27 – 30 December 2020** at **Bhubaneswar**, to be organised by **Bhubaneswar Regional Centre**, IChE. **Email:** [chemcon2020@gmail.com](mailto:chemcon2020@gmail.com)



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**We are happy to present the IIChE e-Newsletter in a new format since Issue 1, 2019. As part of the initiative, we invite from our Members:**

- i. Brief notes (approx. 100 words) about their outstanding achievements in recent period. (News about receipt of awards, fellowships, honour, major promotions, etc.), accompanied with a coloured PP photograph of the concerned Member, will be welcome.
- ii. Industry News (approx. 100 words).
- iii. Concept note on newer areas of R&D (approx. 500 words).

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