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SRESA Newsletter

Jul.-Sep-2022 Issue-3

A quarterly publication of Society for Reliability and Safety [Reg. No. 3141/2010/G.B.B.S.D.], Mumbai

Editor
Prabhakar V. Varde

SRESA Mission

SRESA is working on developing a report on the state-of-the-art in Risk and Reliability in India. To this effect, a survey is being made amongst the major institutions involved in R&D and Academics, as also Industrial houses involved in modelling risk and reliability of complex engineering systems.

The first article under this program on Centre for Reliability is being published herewith.

From the President's Desk ....

A general look at the newspaper headlines is sufficient to sensitize all of us the operations management is becoming an important aspect of National conscious in general and humanity at large. Be it aviation, political systems, road and rail transport, space systems, defence establishments or healthcare, emergency management due to natural calamities, to name a few. In fact, even though governments are doing their level best, there is a need to make people society conscious of risk-management aspects. Operational risk-consciousness is the key eliminate ot avert the adverse consequences, in terms fatalities, loss of property, environmental impacts, etc.

SRESA's new initiative is to develop a document on state of the art on Risk and Reliability Programme in India such that requirements for future can be identified for further consolidating the cacademics and R&D in INDIA on Risk and Reliability. Therefore, we are requesting major institutions in India to provide the detailes of their program and future targets. This issue starts with a feature article on Center for Reliability, Chennai. We will publish organizational input as an article such that readers also become part of this initiative.

Keeping in view the initial discussion, there is an article on Risk-conscious Operations management that – provides a brief account of major features of risk-conscious culture.

Prabhakar V Varde

In this issue ....

CENTRE FOR RELIABILITY, Chennai

Centre for Reliability (CFR) was established by the Government of India in the year 1982 to facilitate enhancement of reliability of Indian electronics & information technology products. CFR strives to compliment and supplement the efforts of the Indian Industries to deliver world-class products and services. This is achieved by providing state-of-the-art services in the field of RAMS – Reliability, Availability, Maintainability and Safety.

CFR, India located at Chennai is functioning under Standardisation, Testing and Quality Certification (STQC) Directorate, Ministry of Electronics and Information Technology (MeitY). CFR works closely with several National & International Organizations and has been providing reliability services along with advanced level training programmes in Quality & Reliability. The Centre offers unique Reliability Engineering services to industries, Govt. Organizations, and private institutions.

1. Background and Genesis

Reliability is the most respectable word in human life and so is the case with products and services. Anybody would like to buy reliable products and would like to avail the services that are reliable. Those products and services that are successful internationally are known for their high quality and reliability. Centre for Reliability (CFR) is an organization dedicated to the cause of improving reliability of the products and services.

During the recent past, CFR Scientists are serving as extended arms of industrial teams, design organizations located at various places in the country. We are striving hard to impress the designers to design for reliability in the interest of their own business as well as to build a brand image for Indian products. Reliability and Failure Analysis are part and parcel of design activity. CFR carries out reliability prediction, based on Component Stress details, to serve as a yardstick for reliability of the product as well as to bring out the vital few components that are reliability critical. The Failure Modes, Effects & Criticality Analysis (FMECA) services rendered by us helps in identification of those components, whose performance will affect the system function critically.

Dramatic improvement in reliability of the products can be achieved through consultancy on Reliability Growth Testing such as Highly Accelerated Life Testing (HALT) & Highly Accelerated Stress Screening (HASS). Reliability analysis/prediction, Reliability Growth Testing and Reliability Demonstration / Determination Testing shall form part of the product life cycle.

CFR contributed in inculcating reliability consciousness amongst industries and academia under the Skill India initiative of Government of India. STQC-CRE, a course designed under Skill India has already been conducted for the budding Engineers and Research Scholars. Failure Analysis consultancy services of CFR is utilized by many organizations for analyzing the cause of failure of the electronic components in addition to its being used as part of reliability innovation projects. Thus, CFR is a `Reliable Gateway' for `Reliability Innovation Solutions' that is always open. Let us work together for building the brand image of Indian products.

2. CFR's Unique Strengths

Reliability Analysis is the core activity of CFR. CFR derives its strength from past experience in executing major projects at National level and competitive projects from industry. Some of the major projects successfully completed are:

1. Reliability studies for the following
    - Towed Array SONAR systems for Submarines for NPOL, Kochi.
    - Electrical control system of second Launch pad for SHAR Centre, Sriharikota.
    - Subsystem of PSLV/GSLV for ISRO.
    - Subsystem of Light Combat Aircraft (LCA), DRDO.
    - Storage Life demonstration testing for Sub-assemblies of INAR missiles for BDL, Ministry of Defence, Bhanur.
    - Primary Radar of CABS, Bangalore.
    - Heavy Weight Torpedo, for NSTL Vizag.
2. Reliability, Availability & Maintainability (RAM) studies of Anti-Collision Device (ACD) for Konkan Railway.
3. Consultancy and Training on Reliability Management for ISPAT, Mumbai and HPCL, Vizag Refinery, Vizag.
4. Highly Accelerated Life Testing (HALT) & Reliability Determination testing (RDT) for
    - UPS, Dot Matrix Printer, Point of Sale Machine for TVS Electronics.
    - Window regulator, HVAC, Instrument Cluster unit for Automobile, Mahindra and Mahindra.

3. Services Offered

In the liberalized global market scenario, Indian industries have to compete with high reliability products from all over the world. Cosmetic reliability touch may lead to considerable loss in the confidence on the products amongst customers leading to loss of revenue and reputation. CFR renders the following services to build products of high reliability

- Reliability Prediction
- Failure Mode Effects and Criticality analysis
- Fault tree analysis
- Consultancy on HALT and HASS
- Consultancy on Failure Analysis of Electronic Components
- Field Failure Data Analysis
- Training and Certification of Industrial Employees in the field of Reliability Engineering
- Reliability Determination/Demonstration Testing(RDT)
- Quantitative Accelerated Reliability Testing

Scope of Services

The above services are utilized by the following sectors of industry:

- Electrical / Electronics Industries
- Software and Information Technology Institutions
- Engineering and Process Control Industries
- Electromechanical Industries

Benefits of Reliability Engineering Techniques are

- Scientific approach to design of improved and assured reliability product at optimal cost

- Identify potential design, manufacturing and maintainability problems
- Reduced warranty failures and reduced warranty cost
- Improved field Reliability/Mean Time Between Failures (MTBF)
- Cost reduction by optimization of Spare requirements
- Minimized manufacturing defects in delivered hardware

4. Details of Activities

4.1 Reliability Prediction

Reliability Prediction is an assessment of the design capability. The accepted measure of the reliability of a system is Mean Time Between Failures (MTBF). Reliability Prediction can be carried out based on MIL-HDBK-217F Notice-2 (DOD, USA) using software tools to compare designs, plan for improvement and arrive at a target Reliability for the product. This exercise will also bring out the vital few components that contribute to poor Reliability and hence improvement in design can be achieved through redesign of parts and subsystems and selection of components of established reliability. Key Benefits of Reliability Prediction are as follows:

- Highest contributors to failure can be identified
- Alternate designs can be easily compared.
- Sensitivity of design to Electrical & Thermal stresses can be evaluated.
- Reliability goal can be set at various stages of product development.

4.2 Failure Modes, Effects and Criticality Analysis (FMECA)

FMECA is design analysis tool to identify critical parts, based on analyzing effect of individual part failure on the overall system. It is an exercise carried out at the design stage for electronic and electro-mechanical system to identify the critical components and take appropriate corrective and preventive action. The problem areas can be given attention to minimize the effect of the failure of such components.

Once the design is matured, modifications will be very expensive. FMECA helps to avoid this expenditure. FMECA also ranks the problem areas depending on the implications of each of them in overall system performance. FMECA as per MIL-STD-1629-A and Risk Priority Number (RPN) Techniques are taken up. FMECA is applicable for all type of systems. Key Benefits are:

- It enables the designer to know the weaker links and provides systematic approach to eliminate design weaknesses
- Identifies critical components with respect to its severity and probability of occurrence.
- Provides basis for trouble shooting procedures and built-in diagnostic features.

4.3 Fault Tree Analysis (FTA)

This analysis is very useful for safety critical applications. Fault Tree Analysis (FTA) is the process of reviewing and analytically examining a system in such a way as to emphasize lower-level fault occurrences, which directly or indirectly contribute to the major fault or undesired event.

Any system fault is traced down to the subsystem or component level using logic gates (AND, OR etc.) and depicted as fault tree and further analysis carried out to evaluate reliability parameters such as unavailability, minimal cut sets, total down time etc.

FTA is extremely useful for identification of potential design defects and safety hazards, evaluation of human and software interfaces, preparation of troubleshooting manuals etc. FTA offers exciting new possibilities for design and Reliability analysis of multi-component circuits in areas such as

- Petro-chemicals
- Telecommunications
- Nuclear Power Stations
- Aerospace
- Offshore Oil Platforms
- Heavy Engineering Industry

4.4 Consultancy on HALT & HASS

Highly Accelerated Life Testing (HALT) is a process for precipitating latent defects and surfacing design and process problems quickly and effectively. It is a preventive testing method to identify design and process problems early in the development cycle. Due to corrective and preventive actions taken as a sequel to the failures, the reliability of the product grows. This results consequent reduction in field failures and therefore, lowers warranty cost. For a wide range of commercial products, HALT has been found to be an effective diagnostic tool for understanding existing field problems, potential quality problems and latent design problems.

HALT is also used in developing an effective Highly Accelerated Stress Screen (HASS), to be used as part of the manufacturing process. HASS allows discovery of problems due to process changes in manufacturing and prevents products with latent defects from getting into the field. Key benefits are:

- To precipitate latent defect.
- Stimulated method to activate design & process weaknesses.
- Reduce warranty cost.
- Improves product reliability.

4.5 Reliability Determination Testing (RDT)

The Reliability Testing of products would provide a MTBF value, more closely related to the real-life performance of the product. The MTBF values achieved from Prediction methods often do not match with the field

performance of the products due to variation in design, engineering, and manufacturing process. Reliability Determination Testing has become the necessity to provide useful feedback on the Reliability performance of the products. Under this activity our services include:

- Design of Life Cycle Profile
- Selection of proper test plan for achieving the desired Reliability at a stated confidence level.
- Carry out Reliability Testing as per the plan and determine the Reliability Parameters viz. MTBF, Failure Rate etc.
- Report the relevant failures to the customer and if necessary, undertake failure analysis. Give feedback for taking corrective and preventive action.
- In the absence of accurate field failure data of products, the Reliability Testing exercise is a vital activity to provide more accurate MTBF on the achieved Reliability of the product at a desired confidence level

Energy Meter Test Bench

4.6 Quantitative Accelerated Reliability Testing (QART)

Quantitative Accelerated Reliability Testing (QART) is carried out on products to quickly estimate the Reliability characteristics of the products. This type of testing is conducted at elevated stress levels. A suitable life vs stress model will be adopted, and testing will be conducted at different stress levels. The number of samples required and the number of experiments to be conducted will be decided based on the no. of stress parameters and the level of each parameter. Failure data obtained at elevated stress conditions will be extrapolated to use conditions and the Reliability characteristics determined. This test will be useful in estimating the Reliability characteristics of production samples. The obtained quantitative estimates can be claimed, published, and marketed. Key Benefits are:

- MTBF determination through accelerated testing.
- Determination of Reliability characteristics like warranty period, B-X life, Reliable life etc.

Testing in Progress

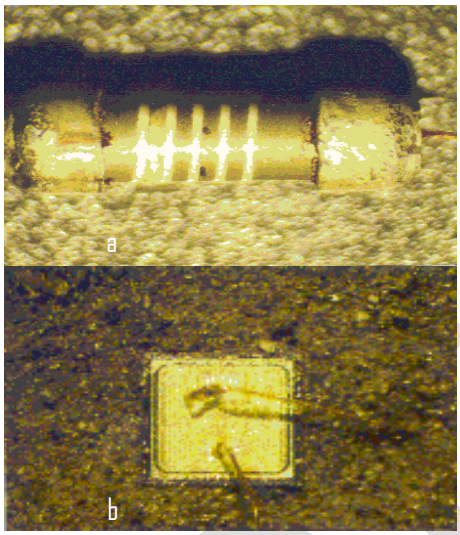
4.7 Life Data Reliability Analysis (Weibull Analysis)

The life data analysis is carried out on the failure data of equipment components/parts and system. The failure data that can be analysed can be from the field or from in-house testing. Truncated test data like right censored data/left censored data or complete data can be analysed and the Reliability characteristics viz, MTTF, B-X life, warranty period, failure rate, Reliable life etc.

The data collected will be analysed with sophisticated state of the art software tools and statistical techniques and the estimates of the Reliability characteristics are arrived at using robust parameter estimation techniques like Maximum likelihood estimation (MLE), Least square estimation (LSE) methods. The estimates arrived by this method based on past failure data of products/equipment reflect the true picture of the equipment behaviour.

4.8 Failure Analysis

The Centre has over 25 years of experience and expertise of International parlance for providing consultancy on failure analysis of electronics components including semiconductors, passive components etc. Both the suppliers and users of electronic components find this very beneficial. The Centre can help in arriving at appropriate solutions to enhance manufacturing yield and proper field usage of electronic Components.



a) View of corrosive attack near one end cap of a Resistor,
b) View of Oxide breakdown and ESD failure in MOSFET

Failure analysis is critical to any engineering aspects pf electronics, be it design, operation, maintenance management or ageing studies. Following are some of the major arguments in favour of developing a failure analysis or root cause analysis program:

- Failure Analysis will identify whether the component failure is due to manufacturing process defect or a misapplication failure and thereby prevents recurrence of such failures.
- Failure Analysis can result in valid recommendation regarding component design, application of proper qualification tests and screening methods.
- Failure Analysis can identify the most failure prone component and recommend substitutes.
- Failure Analysis can assist in the selection of electronic components for a given product application.

5.0 Training Programs

- Certified Reliability Professional (CRP)

Centre For Reliability (CFR) has designed a five-day exhaustive training program on Reliability Engineering Tools and Techniques for professionals from industry and user organizations. This is a flagship program of the Centre for over two decades. The program focuses on all the essential topics in Reliability Engineering, such as Reliability Prediction, Design Reliability Assessment & Improvement, Reliability Testing & Screening and Maintainability & Availability of the product. The body of knowledge is based on the Certified Reliability Engineer (CRE) program formulated by American Society for Quality (ASQ), USA. An examination will be conducted at the end of the program and successful candidates will be issued Certified Reliability Professional (CRP) Certificate.

OBJECTIVE

- To provide sufficient knowledge to the participants to evaluate and improve Product Reliability, Availability, Maintainability and Safety.
- To prepare participants and in turn their organizations to the level of International Standards in Reliability Engineering.
- To Certify the expertise of professionals in the area of Reliability Engineering.
- To provide training in Reliability Engineering as per the curriculum of American Society for Quality (ASQ), USA, a renowned global institution for Quality and Reliability.

6 Skill India Initiative

Centre For Reliability (CFR) has designed a three-day skill-oriented training program on Reliability Engineering Tools and Techniques, STQC-CRE, exclusively for budding engineers and Research Scholars. Tailor made workshops with lab exercises have been included as part of the course curriculum. Separate courses have been framed for Electronics, Communications, Computer Science, and Information Technology streams.

The major objectives are

- To provide appropriate skills at the graduation and post-graduation levels of Engineering stream so that the budding Engineers are armed with employable skills.
- To inculcate the entrepreneurship spirit amongst the upcoming Engineers.
- To make the young Engineers abreast of the latest State of the art Reliability Engineering skills
- To Certify the expertise of professionals in the area of Reliability Engineering.
- To provide training in Reliability Engineering as per the curriculum of American Society for Quality (ASQ), USA, a renowned global institution for Quality and Reliability.

Brief Resume of author Dr.R.Muthukumar, Centre For Reliability, Chennai

Dr. R. Muthukumar is the Director, Centre For Reliability, STQC Directorate, Min. of Electronics and I.T., Govt. of India, Chennai. He obtained his Bachelor's degree in Electronics & Communication Engg. from Government College of Engineering, Tirunelveli and Master's degree, M.S. in Electronics and Communication Engineering from the College of Engineering, Guindy, Anna University, Chennai. He also has a post graduate Diploma in Business Administration from Pondicherry Central University. He obtained his doctoral degree in Embedded Systems Reliability from the Faculty of Engineering, M.S. University, Tirunelveli. He is a Certified Reliability Engineer (CRE) by American Society for Quality (ASQ, USA), Certified Information Security Management System (ISMS 27001) Auditor by IIQM, Jaipur and accredited by IRCA, U.K., and Certified ISO 9000 system Auditor by BSI – QA, U.K. He is a Fellow in the Institution of Electronics and Memberships Telecommunications Engineering (IETE, New Delhi), Member in the American Society for Quality (ASQ, USA), Life member in Indian Association for Productivity, Quality and Reliability, (IAPQR), Kolkata, Life member in Indian Society for Probability and Statistics (ISPS) and Life member in Society of Reliability Engineering, Quality and Operations Management (SREQOM), New Delhi.

He has about 32 years of experience in the area of Hardware and Software Testing, Reliability demonstration testing of Hardware and I.T. products, Mathematical and Statistical modeling for Reliability applications and Quality Assurance of Electronics and IT products. He has to his credit over 23 research papers in International and National Journals/Conferences and Magazines. He has attended over 50 National/International conferences in India and abroad in which about 30 are specifically in Reliability Engineering, Embedded Systems Reliability, Reliability Estimation of Computer Systems, Statistics, Censoring and queuing theory. He has been invited to chair sessions and deliver keynote address in many conferences held in Atomic Energy Labs, DRDO Labs, IIT, Kharagpur, Delhi University, Anna University, Guindy Campus, M.S. University and many other organizations and Institutions. He has been trained in Software Quality and Reliability in U.K., France, USA and Germany. He has guided many research scholars, doing their Ph.D. in Electronics and Reliability Engineering.

He was the project leader for Reliability studies of various subsystems of PSLV/GSLV rocket systems like on-board computer systems, Minicharge Amplifiers etc., for ISRO, Light Combat Aircraft and Advanced Light Helicopters for DRDO Labs, Verification and Validation of Anti-Collision Device (ACD), Axle counter systems for Railways and various other projects from automobile sector. He is also the project leader for implementing "Reliability Management Process" for Vizag Refinery of Hindustan Petroleum Corporation Ltd., Vizag. He was project leader for over 20 HALT projects, 6 HASS projects, 26 Reliability Determination Testing projects and 4 Accelerated Reliability Testing projects so far. He has widely traveled across U.K., U.S.A., Germany, Austria, Poland and France.

Risk-conscious Operations Management

....Prabhakar V Varde, Editor SRESA-NL

. As on today there are over 420 nuclear power plantsand 220 research reactors operating world over. Apriori let us celebrate the achievent of nuclear industry for maintaining and sustaining the highest safety standards. Extending this philosophy in terms of introspection as how we can further reduce the risk or accidents. The reason is the the three major accident TMI (1976) USA, Chernobyle (1986), Earstwhile Russian Federation and Now Russia) and Fukushina (2011), Japan required the industry to sitback and do introspection and take the learning lessoss from these accidents . As can be seen the gape between the 1st and 2nd Accident was ~10 years, while between 2nd and 3rd has been ~ 25 years. We can argue that every accident provided a learning lesson and if it is so the nuclear industry reacted positively to reduce chances of accidents. One major observation on the three accident has been that the human error is one of the major contributing factors to the accidents. This should not be interpreted that humen do lots of mistakes, it only means that plant operation eco-system is human action intensive and during emergency the operator has to infer from from the information that is available and take decisions, while emergency scenario poses cognitive challenges that may make decision making a challanfing task.

The question here is what should be the approach for future such that probability of the accidents can be reduced to the lowest acceptable level. There are existing programmes that include:

a) Deplyment of inherent and passive design features such that human intervention may not be required to ensure safety for relatively extended period of time.
b) Development and implementation of plant safety culture. The major objective is to make the organization and individusl more sensitive to safety aspects of the plant in general and inclucate a culture where safety is the overriding priority.
c) Deployment of advanced concepts like SMR (Small Modular Reactor) Systems which are designed such that consequences in public domain are assured to be as low as possible.
d) Excusive studies of potential for Common Cause Failure such that defenses can be provided in the plant to make plant ribust againt CCF phenomenon.
e) Advances in training approaches such that human error can be reduced in operations and maintenance. Use of advanced plant Simulatoisrs along with training on operator information and aids, a robust qualification and training Programme that is expected to ensure higher safety levels.
f) In the existing system use of advanced technologies, like Artificial Intelligece and Machine Learning in developing the operator advisory systems such that cognitive load on operator during emergency can be reduced, by prioviding an aid that works on the on-line data available from the system.
g) Apart from these there elements like stress-tests, development and application of performace indicators, enhanced regulatory oversight and provisions, Use of PRA for operations applications and improved maintenance and surveillance and monitoring strategies like ISI, Conditional monitoring, etc.

The above measures have provided an improved platform for safety management. However, apart from the above, there are certain areas that need to worked upon and this requires a change in the mind set. This is general observation that often the accidents give adequate warning in the form of subtle signals, near-miss, deviation in process and operational parameters that requires attention and corrective action in-time, before these it comes a reality. In respect of this the scope of root cause analysis program need to be extended to cover precursor analysis where the the bottomline should be to reach the human roots responsible for the failures.

The history of accident and post accident scenario suggest that that mind set and situation in general before and after the event, is different. This is reflected in change in priority, human factor and organizational limitation, requirements for modification of re-assessment of consideration of automations, recognition of impact of internal aspects like industrial hazards, fire, flooding, fall of objects, unexpected leakages, and external events including off-site power failure. One example is till fukishima happened it was LOCA where there was maximum focus by safety experts, however, the after the event the Class IV power failure leading to station black out and further degradtion of core thermal hydraulic conditions that led to Hydorgen generation, safety of storage pool showd a different scenarion which was not considered before.

Further, it is also required that if if we are concerned about the 'risk' of accident or risk of loss of plant reqiability and availablity then we should deal with this situation head-on, i.e. use risk reduction as the objective function, Here, One direct advantage is risk is a scientific / mathematical metrics as it is a measurable and helps comprehend uncertainty is a much better manner. This leads to amother major point that emergenes is 'requirement of a 'risk-conscious culture' and not safety culture as safety is not measurable and the concept is imprecise and vague in nature

The post accident scene is very typical, it is a matter of discussion, brainstorming and debate in the conference room of an affected organization. And the wisdom suddenly becomes so profound that generally it is concluded that the causes of the accident has been identified. Had these factors or causes were addressed before the event this event would not have occurred. Often the accident analysis, root cause analysis, interview with site personel forms part of the investigation. Here, the role of precursor analysis Programme as integral element of operations eco-system should be given highest priority.

It is also required that a reference human model should be developed to enhance and capture the human behavior, attitude and factors that adversly affect the attributes. Therefore the human root cause analysis should go further deep down the present metrics involving error of commission, error of ommision, lapse, mistakes. etc., to identify the causes at human level that adversly affetct the performance. If it is organizational errors then the procedural fault, environmental conditions, training issues, management aspects and little further in-depth details would enable reaching the human attitude, behavioural forms that could be responsible for inadequate performance. The advanced methods involving use of PRA for accident precursor analysis is being used extensively to predict the failure in advance. Apart from this, the Prognostics and Health Management techniques that enable tracking the level of degradation in hardware helps recovery action such that consequences of events can either be eliminated or reduced.

All these improvements made under a single umbrela program called risk-conscious-operations management can be very effective in residual risk reduction.

Springer

Invitation for submission of Article

Special Issue on **Life Cycle and System reliability for Next-Generation Computing and Management.**

Spécial Issue Proposal Form

NAME OF THE JOURNAL: Life Cycle Reliability and Safety Engineering

TITLE OF THE SPECIAL ISSUE: Life Cycle and System reliability for Next-Generation Computing and Management.

NAME AND ADDRESS OF EACH EDITOR:

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Dr. Narendra Khatri	Dept. of Mechatronics Manipal Institute of Technology, Manipal A Constituent Unit of Manipal Academy of Higher Education (MAHE) District: Udupi	narendra.khatri@manipal.edu

CV of the Editors: Attached

SPECIAL ISSUE FORMAT:

- Fresh Call for papers from eminent academicians/Researchers in the selected theme.
- 8 to 10 papers will form the SI.

SPECIAL ISSUE ORGANISATION:

Title: Life Cycle and System reliability for Next-Generation Computing and Management.

Abstract:

In recent scenarios, life cycle engineering is more adaptive to evaluate the cost-effective and efficient system modelling those concepts and methods of life-cycle engineering should be used to obtain a cost-effective design during a specified time horizon. The recent developments in life-cycle engineering of next-generation computing architecture based on system reliability, time-dependent reliability, life-cycle maintenance, life-cycle cost, and optimization constitute important progress.

Next-generation computing has transformed the technological challenges with minimum computational optimization costs. The next generation of computing systems integrates cloud, fog, edge, serverless and quantum computing with system reliability. Life cycle management is the primary key factor for the next generation network. Energy management and routing protocol enhancing network life cycle reliability is for the present and future networks. Network generation computing is a growing field widely used as distributed systems. The advanced computing system provides data repositories, improves workflows, simplifies data, and creates real-time insights. It provides an AI-based platform for accessing information in various applications and is extremely popular in the industry and commercial use.

Various techniques, methods, and algorithms have optimized the reliability and life cycle optimization of many systems. Those algorithms can be made more efficient by applying AI-based techniques. They may implement innovative conservation techniques to improve the network performance, including maximizing the network lifespan. The lifecycle-based system reliability provides appropriate management of data amount, and node switching that sends data might provide further energy savings, extending the network lifespan.
The special issue objective is to provide the possibilities of AI-based life cycle systems for next-generation computing networks to explore the low power consumption or energy-efficient techniques and methodologies done by researchers and industrial people. The special issue is converging on original articles, reports, and experimental work based on the life cycle and system reliability for the different systems as Life Cycle and System reliability for Next-Generation Computing & Management.

The following topics are welcome but not restricted to:
Energy-efficient protocol
Next Generation Multi-Access Edge-Computing
Cloud-Fog Architecture-Based Energy Management
Decision-Making for Next-Generation Distribution Network
Prosumers and Internet of Things Devices
Energy Management Systems in Next Generation Network
Edge-Computing for Smart Microgrid Energy Management
Life Cycle of Light path in Intelligent Optical Networks
Multi-objective optimization
Life-cycle reliability-based optimization
Multi-state System Reliability
Life cycle risk assessment
Optimized energy management solution for heterogeneous clouds
Nanotubes for Next-Generation Computing
New generation energy systems and future Network
Life cycle cost optimization
Green system reliability assessment
Adaptive Clustering for next-generation wireless Network
Resource Management for Edge Computing Networks

KEYWORDS:
System Reliability
Life Cycle
AI
Next generation Computing and Management
Energy Management

REVIEW PROCESS:
Review process: Double Peer Review Process
Each submission will be verified in "Turn-It-In" for plagiarism. Papers below the 20% similarity index (including bibliography) will be accepted for review.

REVIEW / PUBLICATION PLAN:
Submission Deadline: 15 October 2022
First Round of Review Deadline: 15 November 2022
Notification of Acceptance/Rejection: 15 December 2022
Submission Deadline for revised/Final: 30 January 2023
Publication of The Special Issue: 2023

MARKET

Primary market

Academician, Researchers, Scientists, Industry, PG and PhD students/Scholars in Engineering and Technology

Secondary market

UG Students of Engineering and Technology

Special Note to Editor-In-Chief:

1. Editorial Contact will be Dr. Ajay Kumar Vyas and Dr. Rajeev Arya
2. Review Responsibility of the Thematic Area will be looked after by Dr. Ajay Kumar Vyas /Dr. Rajeev Arya/Dr. Narendra Khatri

However, Acceptance or Rejection of a manuscript will be a collective decision of all Chief Editors-LRSE.

Society for Reliability & Safety (SRESA)

(REG. NO. : F-43051 (Mumbai))

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MEMBERSHIP APPLICATION FORM. **MEMBERSHIP NO*.**

1.	Name of applicant		Affix your stamp / passport size photograph and send a soft copy by email
2.	Qualification		
3.	Affiliation		
4.	Position held		
5.	Specialization		
6.	Official address ☐	Residential Address ☐ (Please tick the address to be used for official communication)	
7.	Brief Bio-data:		
8.	Cell phone number and email address	Email:	Cell No:
9.	Date of birth (DD/MM/YY)		
10.	PAN Number (not applicable for student)		
11.	Type of membership (Tick applicable category)	Petron (By Invitation) : Nil Honorary Member (By Invitation): Nil Life membership : Rs. 2,200/- Membership (annual) : Rs 1200/- Student membership : Rs 500/- (Please tick the applicable category)	☐ ☐ ☐ ☐ ☐
12.	Payment mode: i) Cheque ☐ ii) Demand draft ☐ iii) On-line transfer: ☐ Cheque /DD/online transfer details :.....Date: ..... Amount: ..... Name of the Bank:.....Account number.....ISFC code		
12	Signature of applicant:		

- Please send the scanned copy of the form duly signed by email to Secretary, SRESA along with a soft copy of the passport size photograph to secretary@sresa.org.in and a copy to treasurer@sresa.org.in
- SRESA account details are as follow: Money to be transferred in favour of 'Society for Reliability and Safety', SRESA Account number: 31110442604, Bank Name: State Bank of India, Branch: Anushaktinagar, Mumbai 400094, Branch Code 010124, IFS Code: SBIN0010124.
- *will be allotted by SRESA Office.

Managing Committee (2018 - 2023)

Hon. President
Prof. Prabhakar V Varde
Hon. Secretary
Dr. Alok Mishra
Hon. Treasurer
Dr. Manoj Kumar

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