Enhanced Resilient Plant 2019 Workshop Summary



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Ongoing initiatives in the nuclear industry seek to enhance the safety and improve the economics of existing nuclear power plants. These initiatives include efforts to develop Accident Tolerant Fuels (ATF), to optimize the implementation of Diverse and Flexible Coping Strategies (FLEX), to extend the response time of Terry Turbine-related systems, and to develop passive cooling systems (e.g., the Dynamic Natural Convection system being developed by NuVision Engineering and DYNAC Systems). All of these have the potential to offer longer coping

Figure 2. Enhanced Resilient Plant Workshop.

time for operator mitigating actions during plant abnormal operations or severe accident conditions. Longer coping time, for example, will support the enhanced use of FLEX equipment and accompanying mitigating strategies in design basis and beyond design basis events. The collective changes to plant response capabilities and safety margins that may result from these types of technologies may contribute to nuclear power plants that are more resilient to off-normal events. The benefits of enhanced resilient plants are envisioned to be safety enhancements, risk reduction, and economic improvements.

The safety and risk benefits of these technologies have to be quantified and monetized such that the investment of these technologies can be justified. Since different approaches, assumptions, data, and computer codes are being used by different stakeholders, the evaluation of these technologies may result in varied conclusions. Consequently, there is a need to "harmonize" the analysis methods wherever possible. To that end, the RISA Pathway organized an Enhanced Resilient Plant workshop in Idaho Falls, Idaho, on July 30 and 31, 2019. There were over 40 attendees from 19 different domestic and international organizations who participated and contributed to the workshop (a photo from the workshop is shown in Figure 2). The primary topics of this workshop were to:

1. Discuss technologies that can contribute to the enhanced resilience of nuclear power plants.
2. Present approaches being used to analyze and evaluate these technologies.
3. Benchmark approaches and identify opportunities to coordinate activities.
4. Develop a schedule of efforts and outcomes that may contribute to the needed capabilities to support the deployment of resilient plant technologies and the means for evaluating their impact on plant safety and economics.

After two days of intensive presentations and discussions, several key points emerged from the meeting and discussions, and are summarized as follows:

1. Business conditions require the nuclear industry to change its practices. It is a prerequisite to identify how advanced technologies will be able to realize economic benefits before their adoption. It is imperative to have solutions implemented within the next 3 to 5 years.
2. Key industry priorities to achieve cost reductions:
   a. Near-term ATF deployment (coated claddings) with batch reloads in 2023
   b. Widespread deployment of digital I&C to replace obsolete analog systems
   c. Risk-informed licensing and security
   d. Flexible plant operations (e.g., "load following").
3. Major areas where research is needed to support industry directions:
   a. Human Reliability Analysis – particularly to obtain more realistic credit for the use of FLEX
   b. Common cause failures that drive risk insights.
4. Successful industry deployment of ATF will require a comprehensive change management plan. To meet the goal of batch reloads in 2023, this needs to be addressed starting now.
5. Dynamic Natural Convection systems have significant potential for plant safety improvements. An assessment is needed as to whether (and if so, how) this system can provide economic benefits.
6. Engage the regulator at an early stage so critical issues can be identified and resolved and the NRC can allocate resources appropriately.
7. Any future use of dynamic probabilistic risk assessment tools will need to address constraints from end-users. It is recommended to focus on how the analyses can be performed in a timeframe in which the utilities/NRC need to make decisions using computational capabilities that are available to these end-users.

This workshop provided participants with a better understanding of methods and modeling approaches, as well as a vision for future research and development directions, which would contribute to the enhanced resilience of nuclear power plants and permit plant operators to enhance safety and economic performance. The "Enhanced Resilient Plant (ERP) Workshop Presentations and Summary" report INL/MIS-19-55260) was developed from the Enhanced Resilient Plant workshop and is available on the LWRS Program website under the following link:

https://lwrs.inl.gov/SitePages/EnhancedResilientPlantWorkshop.aspx.