

Modular Design – A Challenge and an Opportunity

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New Nuclear Plants

- All new nuclear plants in the United States are expected to use modular design.
- This is expected to provide construction efficiency and enhanced quality.
- A module will result from prefabrication, preassembly, and offsite fabrication.



Definition of “PPMOF” per the Construction Industry Institute

- **Prefabrication:** a manufacturing process in which various materials are joined to form a component part of a final installation.
- **Preassembly:** a process by which various materials, prefabricated components, and/or equipment are joined together by different crafts at a remote location for subsequent installation as a sub-unit.
- **Offsite Fabrication:** a practice or preassembly or fabrication of components both offsite and onsite at a location other than the final point of installation.
- **Module:** a major section of a plant resulting from a series of remote assembly operations and may include portions of many systems.



Upper Drywell Pipe Module

(courtesy of Hitachi)



Benefits and Barriers

- **Benefits**

- Cost reduction
- On-site staff reduction
- Earlier defect detection
- Schedule and cost risk reduction
- Quality enhancement
- Worker safety
- Resource leveling

- **Barriers**

- Increased engineering earlier in the process
- Transporting modules – site specific
- Maintaining process control
- Cross-discipline communication
- Factory management
- Documentation created in multiple, probably global, facilities



CM Challenges

- Design activities for modules manufactured in a factory or other off-site location must be completed early and maintained.
- In-factory or other off-site location qualification and testing will be started and completed early. This qualification and testing will have to be integrated with other tests done after installation.
- Appropriate shipping, storage, and installation procedures will have to be used to maintain the in-factory qualification and testing.
- Certification documentation for modules will be generated in multiple locations and will be “area-based” and not “system-based”. This has to be consolidated for ITAAC Closeout.



ITAAC

- ITAAC – Inspections, Tests, Analyses & Acceptance Criteria. ITAAC are a provision of 10 CFR Part 52.
- Satisfactory completion of all ITAAC will ensure that the plant has been constructed to the requirements of the Design Control Document (DCD) and can be operated safely.



ITAAC CLOSEOUT PROCESS

- Once an ITAAC has been completed, an ITAAC closure package will be assembled.
- It will include all required documentation including the ITAAC closure letter.
- The ITAAC closure letter is submitted to the NRC.



ITAAC MAINTENANCE

- Once an ITAAC is closed out, it must be maintained in an acceptable state until plant start-up.
- The ITAAC will be maintained by a combination of design control programs, corrective action programs, and preventative maintenance programs.



Key Documents

- NEI 08-01 – Industry Guideline for the ITAAC Closure Process Under 10 CFR Part 52
- NEI 08-02 – Problem Identification and Resolution for New Nuclear Power Plants During Construction
- NRC Draft Regulatory Guide DG-1204, Guidance for ITAAC Closure Under 10 CFR Part 52



Ongoing EPRI Project

- Define module qualification and testing that may be done at the manufacturing facility or other offsite location.
- Define methods to be used to preserve qualification or tests during shipping, storage, and installation. Define environment, shipping, storage, installation, field fit-up, etc. that maintains the qualification performed at the factory.
- Propose supplement to NEI 08-01.



Benchmarking

- The amount of in-factory qualification and testing that other industries have determined was "possible and practical" in remotely fabricated modules will be defined.
- The shipping, storage, and installation procedures used to maintain the in-factory qualification and testing will be defined.



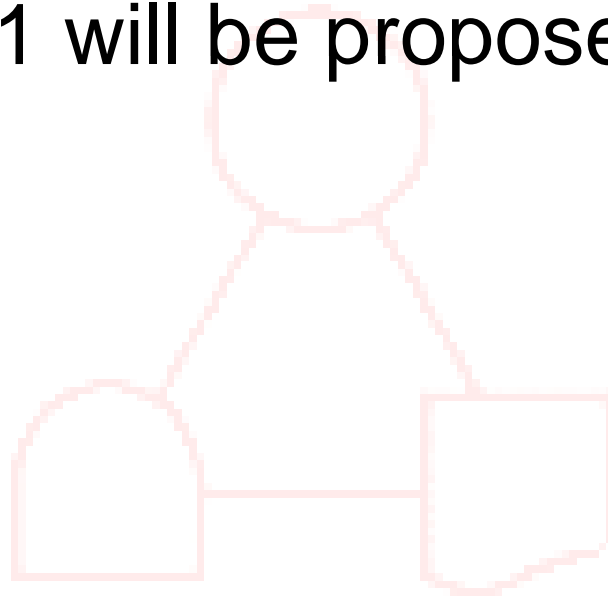
Application to the Nuclear Industry

- Define the applicability of the methods seen in the benchmarking to modularization in the nuclear industry.
- Define all the testing and qualification that could be conducted at the module manufacturing facility.
- Define procedure requirements that will preserve the module manufacturing facility testing and qualification during shipping, storage, and installation of the module.



Propose Supplement to NEI 08-01

- Recommended changes and supplements for NEI 08-01 will be proposed.



CM Enhancements

- CM needs to accommodate the use of 3D virtual plant models.
- CM will experience increased electronic documentation.
- Bar codes, RFID, and other new technologies will be used to track commodities.
- Single repository of data will drive inclusive impact tracking.
- Electronic sign-offs can replace paper.
- Others?



Questions?

