Outline

• What steps should a utility take to create the right framework to successfully deploy a new nuclear power plant?

• How can a utility establish a successful partnership with an EPC company that will last through the project duration (7-10 years)?

• What are the recent lessons learned from projects currently under construction in China and the U.S.?

• What challenges are unique to nuclear and how are they overcome?
Step One: Identify Appropriate Need for New Power Generating Unit

• What amount of power is needed?
  – What size unit(s) is (are) needed to match your requirements?
  – What are the costs and benefits of various reactor sizes?
  – Who are the EPC contractors who have built these size units?
• What type of nuclear technology do you seek to deploy?
  – Pressurized water reactor, boiling water, or small modular?
  – Does your technology selection match up with the contractor?
• What is timing for deployment?
  – If you need the power in 7-10 years, have you started soon enough?
  – Are there additional transmission requirements for the project?
  – Can the EPC contractor deliver your plant in time needed?
Step Two: Identify Capabilities Host Utility has to Oversee Plant Design, Procurement and Construction

- Does the utility have robust engineering capabilities? Can utility self-manage an engineering contract?
- Does utility have experience and staffing to conduct procurement of plant components?
- Does utility have a large organization that can manage interface between multiple contractors?
- Interface problems can lead to risks of delay, extra cost to owner and less optimized performance.
Step Two: Identify Capabilities Host Utility has to Oversee Plant Design, Procurement and Construction (cont.)

- How much responsibility does the owner want to overtake?
Step Three: Identify Appropriate EPC Contract Methodology

- **Multi-Package (Component) approach:**
  - Maximum coordination/staffing effort for utility
  - Owners are exposed to higher level of risk and oversight
  - Accountability for risks is blurred

- **Split-Package (Island) approach:**
  - Discrete portions of work—systems, buildings broken into packages or islands—among two to five EPC contractors
  - Large owner organization needed to manage interfaces

- **Single EPC Contract approach:**
  - Main contractor assumes responsibility for designing, engineering, procurement, construction, project management and commissioning
  - Reduces the need for a larger utility organization
  - Accountability for risks is clearer: contractor, owner or shared
Step Four: Establish the Qualifications of Your EPC Contractor

- Have they built a plant of this type and magnitude before?
- Do they have prior and current experience as an EPC contractor for large, complex projects?
- What relationship do they have with the owner of the underlying technology?
- What prior and current experience do they have in working in a highly regulated nuclear environment?
- Do they have the procedures, policies, processes and people (“Four P’s”) to successfully execute the completion of multi-billion-dollar projects?
Step Five: Ensure EPC is committed to Institute of Nuclear Power Operations (INPO) Principles of Excellence

- Do the leaders demonstrate alignment on a commitment to excellence?
- Can the contractor provide strong first-line supervision?
- Are the personnel appropriately trained and qualified for their jobs?
- Are schedules realistic, understood and achievable?
- Is there a recognition that nuclear construction has special requirements?
- Does the contractor place a high priority on personnel safety?
- Will the contractor ensure that the plant will be built as designed?
- Are deviations and concerns identified, communicated and resolved promptly?
- Does the deployment plan include a early transition to plant operations?
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Establishing a Productive Partnership with an EPC Contractor

• Utility’s Goal
  – High level of reasonable certainty in pricing, schedule and performance for reduced risk
• EPC Contractor’s Goal
  – Owner/contractor structure focused on successful project with acceptable profit and incentives for reduced risk
• Challenge
  – Creating cooperative owner-contractor team with shared focus on project success and mutual risks
• Ultimate Joint Goal
  – Establish relationship of mutual trust and respect to achieve timely and cost-effective completion of project with shared balance of risks and incentives that can survive project duration of 7-10 years
Establishing a Productive Partnership with an EPC Contractor (cont.)

• Achieving Ultimate Joint Goal
  – EPC must understand safety culture and have prior experience
  – Contractor must accept responsibility for managing overall project
  – Utility must have appropriate quantity of personnel to oversee project without inefficiency
  – Project success can be achieved through balanced relationship with appropriate incentives and milestones
  – Utility team focus should be on helping contractor succeed while fulfilling contractual obligations and interests
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• What challenges are unique to nuclear and how are they overcome?
China Project Overview

• Project overview:
  – Six AP1000 nuclear power units; two at each site
    • Sanmen
    • Haiyang
    • Xianning

• Shaw scope:
  – Engineering
  – Procurement
  – Commissioning
  – Project management
  – Technology transfer
  – PM / Technical Support of Xianning

• Duration:
  – 2007 – 2015
Sanmen Units 1 & 2

March 2009: First Nuclear Concrete
Examples of Concrete Placement and Quality
Operating Experience/Lessons Learned

• Lessons Learned:
  – The mix must be perfect—it is 50 percent of the success ratio
  – Temperature, humidity and wind are the biggest external factors that will affect outcome of the concrete pour
  – The time of travel from the batch plant to the project is key

• Best Practices:
  – Have on-site batch plants to guarantee right mix and reduce travel time
Vogtle Units 3 & 4

March 2011: Two concrete batch plants for use during construction of Units 3 & 4
Sanmen Units 1 & 2

August 2009: CA20 Module Installation
Examples of CA20 Module Operating Experience/Lessons Learned

- **Lessons Learned:**
  - Maximize effort in fabrication shop vs. field
  - Rigging techniques and load leveling (lessons learned for next iterations)

- **Best Practice:**
  - Readiness reviews conducted with entire team
  - Detailed as-built surveys of CA20 and the base mat dowels, minimized the interferences on the base mat during setting
CA20 Sub-Module Configurations
Examples of Module Assembly Building Operating Experience/Lessons Learned

• Lessons Learned:
  – Weather can have major impact on modular assembly
  – Welding practices have potential to stress and/or bend modules

• Best Practices:
  – On-site modular assembly buildings provide better protection of modules
  – Vertical welding reduces stress on modules
V.C. Summer Units 2 & 3

August 2010: Module Assembly Building
Sanmen Unit 2

August 2010: Layer 1 Steel inside the CVBH of Unit 2
Examples of CVBH
Operating Experience/Lessons Learned

• Lessons Learned:
  – Sufficient qualified welders
  – Pre-heat treatment method
  – Improvements in design and fabrication of spider block and the lifting beam

• Best Practice:
  – Set within 10 mm (.34 inch) of location
  – Readiness Review Package and punch list
  – Preparation and implementation for the safe and smooth transport and setting
Sanmen Unit 1 CA01 Module

Two 24 axle transporters are prepared to move CA01

March 27, 2010: The 1030 ton CA01 module is lifted over the CV ring and set in the reactor building
Examples of CA01 Module Operating Experience/Lessons Learned

• Lessons Learned:
  – Interferences of CA01 SG wall bottom channel steel with dowels
  – Transport plan: deflection with the support frame beams identified from the transporter load test stiffener plates were added. Three transporters are recommended for the future AP1000 CA01 transportation

• Best Practice:
  – Planning and implementation of the leveling during lifting, using counterweight basket (lesson learned from CA20)
  – Measurement and survey: CA01 layout survey, embedment, potential conflicting dowels to provide preset info – minimized setting and fit-up problems
  – Readiness review package
Shaw’s AP1000 Operating Experience/Lessons Learned Program

- Operating Experience/Lessons Learned Program
  - Project Experience
  - Construction Evaluation Reports
  - Electronic Database
- Data is Utilized in:
  - Readiness Reviews
  - Project Management Plans
  - Design development
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Challenges Unique to Nuclear Environment

• **Timing**
  – New nuclear unit delivery schedule approximately nine years (vs. seven for coal), with three- to four-year fabrication times for steam generators and vessels
  – Early decision-making is necessary

• **Public Scrutiny**
  – Because nuclear power is such a high-profile technology, potential problems at any site become widely known

• **Uniqueness of Nuclear**
  – Nuclear power is among the most highly regulated activities in the world, so regulations are robust and closely followed

• **Collaboration between Regulators**
  – Nuclear regulators make up a very small community and are far more connected than in any other arena
Challenges Unique to Nuclear Environment (cont.)

• **Robust QA/QC is Vital**
  – Components emplaced in nuclear units require much higher pedigree than those in fossil units

• **Safety Culture**
  – Companies involved in nuclear unit construction must not only foster safe working environments for employees, but must also create a culture at the worksite that prioritizes safety above scheduling and cost concerns

• **Specialization of Contractors & Subcontractors (C&S)**
  – Not all C&Ss have the programs, processes, procedures and people (“Four Ps”) needed to successfully build nuclear operating units
Conclusion

• When constructing a major infrastructure addition (such as a large power plant), the selection of the “best fit” EPC contractor is not merely a function of who gives you the lowest price;

• Instead, the key question a utility needs to ask itself, “Does this EPC contractor have the programs, processes, procedures and people (four P’s) I can trust to successfully and safely execute the project on time and within the agreed pricing framework?”