Competitiveness, Economics and Intangibles of New Nuclear Power Plants - An Implementation Perspective

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Trends in Energy Generation

Trends from 2007-2009:
• Increasing Renewables, Natural Gas
• Steady: Nuclear, Hydro
• Decreasing: Coal, Petroleum
Why is Nuclear so Important?

Nuclear power plant projects address important national and societal needs:

- Climate concerns
- Energy independence
- Diversity of energy resources
- Predictability and reliability of electricity generation
- Stability of electricity costs
- Jobs!

![Diagram showing jobs created for operating energy plants per 1,000-megawatts of capacity.](Sources: Ventyx and U.S. Department of Energy)

*Figure from the Nuclear Energy Institute*
US Electricity Generation

*Data from U.S. Energy Information Administration*
Nuclear Role

• In recent years, nuclear power has consistently provided about 20% of US electricity generation*

• Nuclear power is the largest contributor to “clean” electricity generation
  – In 2009, nuclear power accounted for 69% of US emission-free generation*

• Nuclear power is the most predictable and reliable generation option

• Nuclear power provides low production cost generation

*Data from Nuclear Energy Institute Resources & Stats
Production Costs

*Data from U.S. Energy Information Administration*
Capacity Factor

2008 Data

*Data from U.S. Energy Information Administration
Understanding the Challenge

• It is important to understand industry status as the Energy Policy Act 2005 was passed:
  – New, incomplete plant designs
    ▪ Where a design did exist, significant “Americanization” and/or “Tropicalization” was required
  – New NRC Licensing Process (10 CFR Part 52), along with lingering, unresolved Digital I&C Licensing Issues
  – New construction approaches and methods (for US)
  – Degraded Supplier infrastructure
  – New commercial models
  – New and unproven EPC Teams
• Collectively, these factors represented a considerable challenge
We’ve Made Considerable Progress

• Experience from previous generation US projects and recent overseas projects were studied to incorporate applicable lessons learned into the new US projects
  – Studies on previous lessons learned have been prepared and are being used by all new projects to incorporate key concepts in project planning
  – STP 3&4 being informed by Kashiwazaki, Hamaoka, Shika, Shimani, and Lungmen projects
  – Calvert Cliffs 3 being informed by Okiluto, Flamanville, and Taishan projects
  – Vogtle 3&4 and Summer 3&4 (and other AP1000 projects) being informed by Sanman and Haiyang projects

• Supplier/vendor infrastructure is improving significantly
  – Number of potential suppliers has increased, with major investments in QA Programs, Staff, and facilities
We’ve Made Considerable Progress (Cont’d)

• Important steps forward in NRC Licensing:
  – 10CFR52 Licensing process “bumps” are being smoothed out
    ▪ Design Certification issues being resolved (albeit more slowly than desired in some cases) and COLA reviews proceeding
    ▪ Manageable COL contentions expected for lead projects
  – Observable progress and improved industry/NRC cooperation on digital I&C licensing

• Investments by Owners and Vendors to advance construction and fabrication methods, including modularization and open-top construction

• Considerable progress on detailed designs for ABWR, EPR, AP1000, APWR, as well as active engineering on Small Modular Reactor designs
We’ve Made Considerable Progress (Cont’d)

• Lead projects are procuring Long Lead Material and Equipment
  – Strategies developed to effectively use both US and overseas suppliers
• EPC Teams continue to improve integration, alignment, and effectiveness
• Implications of the commercial terms are being learned and factored into project implementation
• Significant resources invested in detailed EPC project implementation schedules, project controls processes, and project management
• Numerous new jobs created with level of excitement and interest very high
We’ve Made Considerable Progress (Cont’d)

• Cumulative result of this progress is an industry that collectively:
  – Is better prepared to deploy new plants in the US than at any time before
  – Understands project needs, risks, and schedules
  – Continues to complete non-recurring engineering, procurement, and construction planning work that will be usable on future projects
  – and …

• Has set the stage for success, numerous times over
  – While at the same time understands, respects, and is addressing the project challenges
Current Challenges For New Nuclear Projects

• Reduced demand for electricity pushing some projects out in time
  – Recession impacts
  – Natural Gas prices remain low, with many forecasts showing low prices for the foreseeable future

• Carbon regulation remains a question impacting economics
  – Nuclear is clearly a major contributor to climate solutions, the question is timing of regulation

• Although Licensing processes continue to improve, increased confidence in schedules is also needed
  – NRC has goals to reduce review durations for future applications
  – NRC and industry need to continue efforts to align performance and increase confidence in schedules
Current Challenges For New Nuclear (Cont’d)

• Cost and Cash Flow remain significant challenges
  – “Bob – the $/kw number, we like that number a lot, it’s the total cost number that is the problem”
  – Current public estimates are overnight costs of $6B to $8B per unit (or more)
    ▪ Project costs can rival the total market capitalization of the owner
    ▪ These projects can be “bet your company” decisions
  – Project cash flow, and potential diluted earnings during construction, are a significant challenge, especially for projects without “pay as you go” cost recovery
    ▪ Remaining on an aggressive implementation schedule can require spending on the order of 20% to 30% of the cost before the NRC issues the COL (and the Loan Guarantee is finalized)
"A Large Pill to Swallow"

*Data from Google Finance*
Current Challenges For New Nuclear (Cont’d)

• Loan Guarantees and Production Tax Credits reduce risks and improve the overall economics (and help) …

• However – Loan Guarantees in the current form do not fully address the major challenges of the size of the investment required, the pre-COL cash flow, and dilution of earnings
  – They are insufficient alone to provide the “societal push” needed for a robust nuclear renaissance

• These concerns are major drivers for the increasing interest in Small Modular Reactors (SMRs) which:
  – Are typically smaller with corresponding reduced total cost
  – Can be constructed and brought on-line faster and/or incrementally to manage cash flow
What Can We Do?

• A more “Societal Approach” focused on the major challenges
  – Increased efforts to promote/stimulate energy companies to collaborate on new plant projects to share the risks and benefits
    ▪ Partnerships?
    ▪ JAPC Model?
  – Consideration of additional incentives and programs to ease the cash flow and potential dilution of earnings on these capital intensive projects
    ▪ Pre-COL access to Loan Guarantee funds or Bridge Loans?
    ▪ Pre-Operation Tax Credits for investments?
    ▪ Other “Pay as You Go” cost recovery options?
  – Industry wide effort to revisit the bases for total cost to understand drivers and assess options to reduce costs
    ▪ Regulatory?
    ▪ Single vs. multi-unit economics?
    ▪ Cash flow impacts?
    ▪ Other?
• Patience and Perseverance are important
  – The industry is successfully implementing a “plan the work and work the plan” strategy
  – All stakeholders need to support the strategy, stick with it, and allow/support it to play out successfully

• Nuclear power plant projects address important national challenges – We need to be successful!
  – Climate concerns
  – Energy independence
  – Diversity of energy resources
  – Stability of electricity costs
  – Jobs