Technical Meeting – Cost Estimation Methodologies for Spent Fuel Management
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UAE Delegation

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1. Disposal Scenario

Spent Fuel Strategy

- Spent nuclear fuel will be stored in the spent fuel pool to allow cooling.
- Transferred to an independent spent fuel storage facility (ISFSI) to be sited, designed and constructed at the Barakah NPP site.
- It will be stored until disposed in a geological disposal facility, which will be sited designed and constructed in the United Arab Emirates.

Key Points

- Spent Fuel Pool storage capacity 20 years
- Fuel once-through then disposal (in country) - UAE policy and law
- Interim storage on site until GDF (90 years)
- Dry Storage initial siting study conducted
2. Cost Estimate Drivers

Cost Estimate

• Nuclear regulatory (FANR-REG-21) and international best practice drivers

• As part of the IDP – Operating License Application
  • To demonstrate the technical and practical feasibility that BNPP can be decommissioned
  • Provides assurance that decommissioning can be undertaken safely and within the current acceptable limits issued by the Federal Authority for Nuclear Regulation (FANR)

• As the basis of determining an initial annual DTF contribution
  • Future financial assurance
3. Spent Fuel Cost Estimate Methodology

Types of Cost Estimate

The IAEA describes three types of cost estimate that can be used, and each has a different level of accuracy:

i. Order of Magnitude Estimate
   One without detailed engineering data, where an estimate is prepared using scale-up or down factors and approximate ratios. The level of accuracy expected is -30% to +50%.

ii. Budgetary Estimate
    One where the scope has been defined, but the detailed engineering has not been performed. The level of accuracy expected is -15% to +30%.

iii. Definitive Estimate
    One where the details of the project have been prepared and its scope and depth are well defined. Accuracy -5% to +15%.
3. Spent Fuel Cost Estimate Methodology

The IDP used a number of (ISDC/IAEA) recognized methods to develop an Order of Magnitude estimate:

**Parametric Estimate**
- Use of historical databases on similar systems or subsystems.
- Uses statistical analysis on the data to find correlations between cost parameters.
- Produces cost equations or cost estimating relationships

**Cost Review Method**
- Constructed by examining previous estimates of the same or similar projects for internal logic, completeness of scope, assumptions and estimating methodology

**Expert Opinion**
- This may be used when other techniques or data are not available. Specialists are consulted iteratively until a consensus cost estimate is established.
3. Spent Fuel Cost Estimate Methodology

Current Cost Estimate Method

- Cost per tonne of uranium factor
- BNPP Spent fuel forecast
- Applied the forecast to the factor

Reasons for Approach
- BNPP is at construction (in-country information not available)
- Parametric model yields “evidence-based” data
- Intention to continuously improve
4. Risk and Uncertainty

• Estimate is based on a linear relationship between cost and volume
  • Facility cost plus waste handling cost
• Parametric data - inconsistent / non-standard and different per country
  • Waste management methods and waste types
  • Regulatory requirements
  • Economy of scale
• Not country specific
  • Regulation
  • Labor costs etc.
  • Future nuclear strategy and economy of scale
• Not site-based
  • Assumed geology / site type and location
• Estimate is focused on decommissioning phase as the driver is DTF
  • Develop cost of SNF through operations
4. Risk and Uncertainty

To increase confidence levels in the data and reduce under/over estimation, the following measures are in place:

Mitigation

- GDF Estimate Contingency
  - Review of UAE and regional major construction projects (>1 B USD)
  - Reported planned cost at project initiation v reported actual cost at project completion
  - Average cost over-run 74%
  - Study complete by major civil engineering consultant (in UAE)

- Regulatory requirement for periodic review (3 years or significant change)
  - Regulatory requirements in place to manage spent fuel cost throughout operations

- UAE (in-country) based cost estimate
  - Decommissioning cost estimate project started
5. Challenges and Opportunities Going Forward

Challenges & Opportunities

• Develop and enhance the cost estimate to provide greater confidence levels and accuracy
  • Less parametric and more in-country focused model
  • ISDC standard – bottom up approach where practicable
  • Contingency will be developed in future using risk-based Monte-Carlo modelling (yield confidence levels)

• Develop cost evaluation for SNF during operational phase
  • Bottom-up in-country approach

• UAE Waste Management Organization – to be developed (ENEC)
  • Develop GDF research program

• Use data from operations once “on-line” to forecast

• Develop an international forum where operators can regularly discuss challenges and opportunities and share best practice
Questions

Thank you