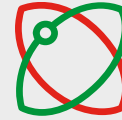


مؤسسة الإمارات للطاقة النووية  
Emirates Nuclear Energy Corporation



شركة براكة الأولى ش.م.خ  
Barakah One Company PJSC



شركة نواة للطاقة  
Nawah Energy Company



# Technical Meeting – Cost Estimation Methodologies for Spent Fuel Management

5-8 Nov 2019 (IAEA, Vienna)

# UAE Delegation

David Davies:

Nawah, Decommissioning Manager

M Tariq Sharif:

Nawah, Senior Decommissioning Specialist

Abdulla Ateeq Al Hameli:

ENEC, Senior Radioactive Waste Management Engineer

Fahed Al Mulla:

Federal Authority for Nuclear Regulation (FANR)

Suaad Al Hajri:

Federal Authority for Nuclear Regulation (FANR)

# Contents

1. Disposal Scenario
2. Cost Estimate Drivers
3. Cost Estimate Methodology
4. Risk and Uncertainty
5. Challenges Going Forward

# 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**

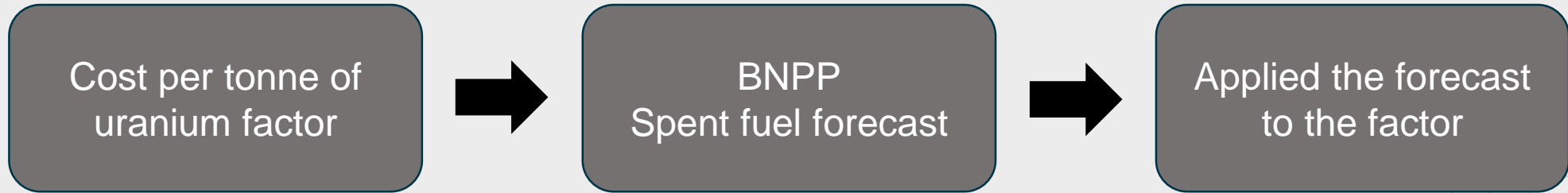
- Constructed by examining previous estimates of the same or similar projects for internal logic, completeness of scope, assumptions and estimating methodology

#### **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



## 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