Project Management of NPP Construction

China Nuclear Industry 23 Construction Co., Ltd.
Exploration and Practice
Challenges and Difficulties
NPP Construction Contents
NPP Construction Flow
General Overview China NPP
Exploration and Practice
NPP Construction Flow

- Feasibility Study on Necessity of NPP
- Pre. Feasibility Study on Introduction of NPP
- Establishment of Nuclear Power Project Plan
- Issuance of Invitation to Bid
- Preparation for Construction
- Gov’t Decision on Introduction of NPP
- Concluding Major Contracts
- Construction
- Commercial Operation
Feasibility Study on NPP Introduction

Analysis

- Trend and demand.
- Economic analysis
- Environmental impact assessment

Evaluation

- Market of NPP business.
- Nuclear power technology
- Development & requirements
NPP Construction Flow

- Pre. F/S for NPP Introduction
- site and reactor type, environmental impact
- Study of infrastructure plan
- Evaluation of national capacity
- Study of nuclear power policy
Establishment of NPP Project Plan

- Plan for establishing governmental organization, laws and development of human resources
- Preliminary selection of plant site
- Initial study of national policy for introducing NPP
  - Technology development including study of reactor type
  - Establishing infrastructure including localization
  - Nuclear power policy on Radwaste disposal, nuclear fuel, etc.
Government Decisions

1. Government’s decision and establishment of policy on introduction of NPP

2. Implementing required administrative processes including parliament’s approval
Preparation on the government’s side

- Establishment of governmental organization and nuclear regulating laws of licensing and safety
- Establishment of industrial infrastructure
- Development of human resources specialized in nuclear power projects
Preparation on the Industry’s side

- F/S on construction of NPP
  - Technical & Economic analysis
  - Selection of plant site
  - Schedule milestones
  - Environmental assessment

Preparation for (ITB)
  - Issuing Invitation to Bid

Establishment
  - Finance plan & basic plan
1. Decision of project scheme according to project conditions

2. Selection of qualified bidders

3. Issuance of ITB

Issuance of ITB
Evaluation of bid proposals received

Selection of successful bidders and concluding major contracts

Securing financing resources and concluding loan contracts
NPP Construction

Obtaining licenses

Implementing construction work

Commissioning
Commercial Operation

- Obtaining operation license
- Fuel loading
- Power ascension test and performance test
- Construction completion
- Start of commercial operation
Process of 1st NPP Introduction

- Feasibility Study on Necessity of NPP
- Pre. Feasibility Study on Introduction of NPP
- Establishment of Nuclear Power Project Plan
- Issuance of Invitation to Bid
- Preparation for Construction
- Gov’t Decision on Introduction of NPP
- Concluding Major Contracts
- Construction management
- Commercial Operation
NPP Construction Contents

1. Project Integration management

- Develop Project Charter.
- Develop Project Management Plan
- Direct and Manage Project Execution
- Monitor and Control Project Work
- Perform Integrated Change Control
- Close Project or Phase
1. Project Integration management

Ensure the project integrity through application of the same date information by every project entity

Drawing & Document Control receiving and distribution

Document status assignment
Project numbering system

Project correspondence
Project meeting and report procedures
Significance of Nuclear Power Field Construction Management

- **EM1**: installation of heavy handling equipments
- **EM2**: installation of main primary system equipments
- **EM3**: installation of auxiliary components
- **EM4**: installation of auxiliary piping
- **EM5**: installation of heating, ventilation and air-conditioning systems
- **EM6**: insulation of equipments and piping
- **EM7**: installation of on site prefabricated tanks
- **EM8**: general electrical installation
- **EM9**: installation of instrumentation
- **EM10**: installation of light lifting equipments (for loads under 40t)
- **EM11**: commissioning services
3. Schedule management

- Ensure timely completion

- Monitoring and Control procedures

- Turn over packages including punch list system TO, room TO, plant TO

Project Milestone
Integrated Project Schedule, Summary Schedules and Detailed working schedules
4. Material Management

**delivery plan**

**deliver equipment and materials to the constructor just in time**

- **A**: procurement
- **B**: delivery plan
- **C**: receiving inspection
- **D**: storage
- **E**: distribution
4. Material Management

- **NOTE:**
  - Completely identification system and control requirements
  - Monitor strictly on circulation process
  - Expensive value, large risk of management
  - Much more non-standard equipment, single channel of material supply, complicated management process
  - Involved major compel laws and regulations
5. Quality Management

- Establishing organization and basic program
- Ensuring quality control depending on importance
- Ensuring procurement management
  - Reinforcing appropriate quality assurance in design, manufacturing, transport, installation
  - Inspecting manufacturers’ quality management performance
- Conducting comprehensive inspection at major milestones
Implementing Mature Quality Management System

Quality, Quality Management and Continuous Improvement

Research on Deming cycle, or PDCA cycle, dates back to the 1920s when renowned statistician Walter A. Shewhart, known as “father of statistical quality control” introduced the concept of “Plan-Do-See”. This PDS cycle was later developed into Plan-Do-Study-Act by Deming as a model of continuous quality improvement composed of four cyclical and repetitive steps of continuous improvement and constant learning, i.e. plan, do, check/study, act. Deming cycle is sometimes referred to as Deming Wheel, or Continuous Improvement Spiral, which is closely related to improvement and instantaneous production in production management.
5. Quality Management

Implementing Mature Quality Management System
Quality Control Mechanism in Nuclear Power Project

Four Everything
- Everything must be regulated
- Everything must be attributable
- Everything must be supervised
- Everything must be traceable
5. Quality Management
Implementing Mature Quality Management System
In-depth Construction of Nuclear Safety Culture

Nuclear safety culture

Nuclear safety culture - nuclear safety culture is the assembly of characteristics and attitudes in organizations and individuals which establishes that as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance.

INSAG-4 Nuclear Safety Culture
5. Quality Management

Implementing Mature Quality Management System
In-depth Construction of Nuclear Safety Culture

Nuclear safety culture system

- Duty and division definition
  - Duty definition
  - Safety practice definition & control
  - Qualification & training
  - Reward and punishment
  - Examination, assessment and comparison

- Regulations such as QA system procedures and work procedures
- Personnel qualification clearance, training & management
- Incentive system formulation
- Inspection & assessment system building

Commitment on policy-making level
- Safety policy statement
- Establishment and improvement of organizational institutions
- Resource supplies
- Self-restriction mechanism
- Questioning attitude
- Rigorous approach
- Habit of communication

Commitment on managerial level

Commitment on individual level

Nuclear safety culture
NPP Construction Contents

5. Quality Management
Implementing Mature Quality Management System
In-depth Construction of Nuclear Safety Culture

- Attention attached by top executives of the project
- Necessary guarantee in resources
- Awareness hierarchical order

- Quality First
- Safety First
- Guideline implementation
- Everybody involved
Attaching Importance to Safety Management & Control and HSE System Construction
A Year-on-year Enhancement for Requirements of Health, Safety and Environment (HSE)

In September, 2009, the stack shared by No.3 and No.4 units on a power plant construction site collapsed and caused major casualties. The incident has seriously affected the general contractor of project and the civil engineering & erection contractor.
A Year-on-year Enhancement for Requirements of Health, Safety and Environment (HSE)

In October, 2009, the steel rebar assembly collapsed during the civil engineering construction of a nuclear project conventional island, causing 5 deaths during rebar-binding below the 11th storey, 3 cases of severe injury and 18 cases of slight injury above the 11th storey. The entire project was ordered to be suspended, leaders of relevant responsibility units investigated and persecuted. The erection company responsible for this accident has completely lost its credibility in the nuclear power construction market.
Objective Assessment of Project Safety Level:

Safety level:

- Primary level (rule-driven level);
- Intermediate level (objective-driven level);
- Advanced level (constant improvement level).
Building HSE Management System:

Multi-project HSE management system:
- Refer to experience of top enterprises on an international scale;
- Based on PDCA theory of constant improvement;
- Solve various problems in a systematical way.
7. Cost management

- The process to ensure completion of the project within the approved budget

- Monitoring and Control procedures
- Cost analysis reports
7. Cost management

Budget Distribution in NPP Construction

Direct cost : Indirect cost = 60 : 40
7. Cost management

The difficulties and measures of cost control

- The adverse effect of market monopolization
- Less capacity of design optimization
- The requirement of compress schedule
- Less of interface management
8. Manufacturing and Installation management

- Qualification of sub-vendors
- Monitor & assess
- On-site inspection
9. HR management

1) Develop Human Resource Plan
2) Acquire Project Team
3) Develop Project Team
4) Manage Project Team
Project Human Resources Mobilization Plan

9. HR management

Overall HR mobilization curve of general construction of nuclear island installation, Line 1 to Phase II

Phase from ATP+16 (June 2006) to ATP+16 (June 2011)

Peak number of people: 2,800
Total number of person-months: 111,616 person-months
Peak number of employees: 877
Peak number of workers: 2,630

The duration with the number of people exceeding 2,800 is 18 months (ATP37-54) (08.03-09.08)
10. Communication Management

- Identify Stakeholders
- Plan Communications
- Distribute Information
- Manage Stakeholders Expectations
- Report Performance
11. Risk Management

1. Plan Risk Management
2. Identify Risks
3. Perform Qualitative Risk Analysis
4. Perform Quantitative Risk Analysis
5. Plan Risk Responses
6. Monitor and Control Risks
General Overview Worldwide
NPP Construction Flow
NPP Construction Contents
Challenges and Difficulties
Exploration and Practice
Challenges in many concurrent new builds

- Limited manufacturing capabilities
  - Main components – long lead components
  - Number of fabricators with the capabilities to build nuclear modules

Lack of construction technologies and management
- Specialized equipment (very high life crane)
- Modularization and piping

Limited human resources
- Labor /resource availability
- Labor union agreements
- Licensing personal capabilities

Competition between newcomer/expanding NPP programme and life extension programme for operating NPPS
Difficulties along the way

- additional licensing requirements, public intervention, suppliers and funding problems have been blamed for most of the delays and cost increases

- Growing recognition that lack of proper construction management has been a major factor for delay

- Construction management is a management specialty primarily concerned with the definition, co-ordination and control of large undertakings, from the points of view of technical quality, schedule, supply chain and costs.
1. Application of Standardized Management

Definition of Standardization:

Definition of standardization: in social practices such as economy, technology, science and management, unify repetitive issues and concepts through formulation, release and implementation of standards so as to attain optimal order and social benefits.
1. Application of Standardized Management

1. Main procedures & Work Manual
2. Experience Feedback
3. Technical Norms & Basic Coding System
2. Application of Intensive Management

"Intensive Management" in Nuclear Power Erection

1. Organization and execution; Formation of expert committee

2. Standardization documents  Concentrated prefabrication  Welding procedure qualification

3. Concentrate training and purchasing

4. Business bidding, evaluation and management of sub-contractors
3. Multi-project Synergy Mechanism

Base of Multi-project Synergy

- Relations, collaboration and division of labor among projects; “1+1>2”;
- Interactive multi-project system;
- Interactions and mutual relations among multi-projects (similarity, mutual complementarity and mobility).
THANKS