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# Power Generation Projects in Developing Countries

**Pakistan Chamber of Commerce - USA**

November 18, 2010



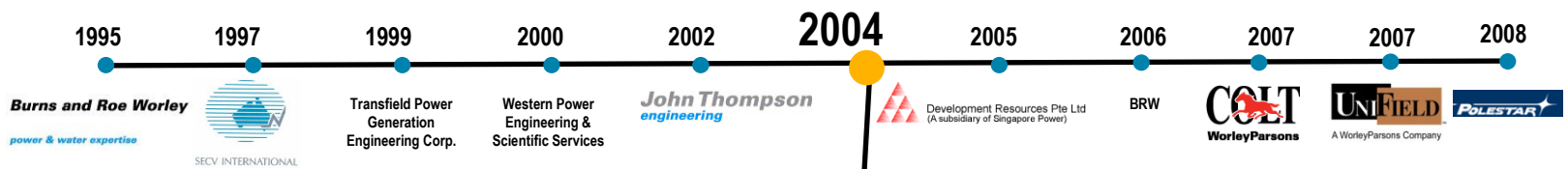


## ► Developing a Coal Fired Power Station

- Performing a Screening Analysis
  - Generation Capacity
  - Generation Technology
  - Air Quality and Emissions Solutions
- Performing a Feasibility Study
  - Selected Configuration
  - Cost and Schedule
  - Market and Means for Entering
  - Financial Proforma
- Developing the Project
  - Sources of Finance
  - Contract Packaging
  - Directing the Risk



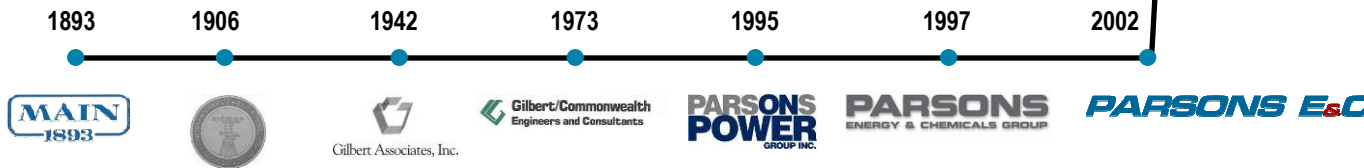
## Worley



## WorleyParsons

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## Parsons E&C



Companies acquired by Worley, Parsons E&C, and since 2004, by WorleyParsons; the latest being Colt, Unifield, and Polestar.



40 countries | 30,000 personnel



**Power – Approx. 2000 staff | 15 offices | 8 countries**



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# WorleyParsons-Designed Plants



**Coal – Over 38,000 MW**



**Gas Turbine – Over 34,000 MW**



**Nuclear – Over 11,000 MW**



## ► Performing a Screening Analysis

- Answer the Basic Questions First:
  - Who, What, Where, When, Why, and How Much?
- Establishment of a Development Entity
  - Government Entity
  - Independent Power Producer
  - Local Cooperative or Municipal
  - Heavy Industrial
- Determination of Configuration and Technology
  - Selection of Preferred Fuel (Coal, Gas, Oil, etc.)
  - Technology Best Suited for Fuel
- Site Selection
  - Near Fuel Source
  - Near Transmission
  - Near Market (Industrial, Residential, Port, etc.)



## ▶ Performing a Screening Analysis.....continued

- Develop a Schedule
  - When is the power needed?
  - Develop from the Back end forward. If needed by X, then when does it start?
- What is the Justification for the Plant?
  - A Shortage of Power
  - A Financial Opportunity
  - Provide Superior Environmental Solution
- How Much...?
  - Capacity
  - Fuel
  - Cost
  - Return on Investment

▶ Answers to these questions should result in a Basic Plan which now must be studied for Feasibility.



## ▶ Performing a Feasibility Study-Based on Decisions of Screening Process

- Finalize Technology including Emissions Control
  - Pulverized Coal – with FGD, SCR, Particulate control
  - Circulating Fluidized Bed
  - IGCC
- Perform Basic Engineering
  - Plant/Site Arrangements
  - Process Flow Diagrams
  - Electrical One Lines
  - Heat and Material Balances
  - Control Philosophy
  - Preliminary Soils Analysis





- ▶ Performing a Feasibility Study-Based on Decisions of Screening Process
  - Project Cost Estimate
    - Capital cost including engineering, procurement, construction
    - Operations and Maintenance Cost including cost of fuel and consumables, cost of maintenance, cost of operations staffing
    - Development costs – licensing and permitting, initial studies
    - Financing Costs
  - Project Schedule
    - Determination of Need Date
    - Accurate lead times for equipment manufacture
    - Realistic Schedule for Construction
    - Schedule of Preliminary Activities



## ► Performing a Feasibility Study-Based on Decisions of Screening Process

- Can the Project Be Permitted?
- Can the Project Be Financed?
  - Sources of Finance
- Can a Reasonable Return on Investment Be Expected?
  - Financial Proforma Analysis





- ▶ **Traditional Utility Style Project – EPCM**
  - Engineer as EPCM Contractor
  - Multiple Purchase Contracts, Multiple Construction Contracts
  - Owner Retains and Manages Risk
  - Financing by Owner – Results in Lowest Cost
- ▶ **Lump Sum Turnkey – EPC**
  - EPC Contractor Assumes All Risks and Responsibilities
  - EPC Contractor Buys All
  - EPC Contractor Manages Risk
  - Commercial Financing by Owner
  - Higher Cost Project





## ▶ Modified Turnkey

- Engineer Hired as Agent/Facilitator/Coordinator
- Multiple Island Contracts
- Island Contractors Assume Risk for Their Island
- Owner Retains Minimal Risk for Overall Project
- Engineer Contract Financed through Institutional Source
- Island Contractors Required to Self Finance
- Medium Cost Project\

## ▶ BOT –Build, Own, Transfer

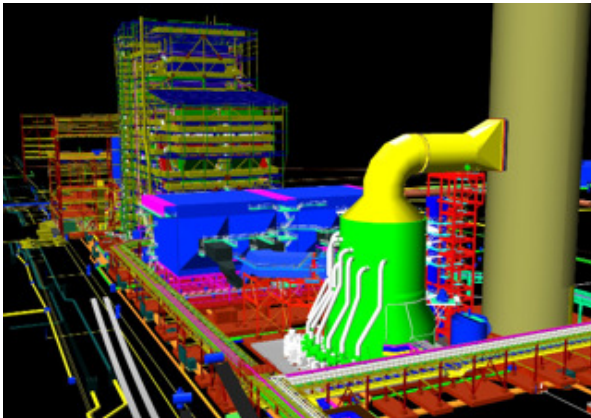
- Similar to EPC
- Contractor Obtains Project Financing
- Owner Pays Contractor at Agreed Time
- Limited Bidders Who Can Provide



# Developing the Project Potential Sources of Financing

## ▶ Institutional Financing - USA

- USTDA – Screening and Feasibility
- USAID – Feasibility and Basic Engineering
- US Export/Import Bank – Finances US Sourced Equipment & Services
- Overseas Private Investment Corp (OPIC) Development Equity Funds
- Development Credit Authority (DCA) – Local Currency Financing



## ▶ Institutional/Multilateral Financing

- World Bank (IBRD) – Normally Require Sovereign Guarantee
- Asian Development Bank
- Islamic Development Bank
- International Finance Corp (IFC) Will lend to Private Sector on Co-Financing Basis
- Political Risk Insurance- Nationalization, War, Foreign Exchange Risks
- National Export Credit Agencies



## ► Risks Associated With Developing a Power Project

- Performance Risks
  - Equipment
  - Contractors
- Schedule Risks
  - Equipment Delivery Delays
  - Construction Delays
  - Delays in Finance Availability
  - Delay in Performance by Others
- Political Risks
  - Change of Government
  - Confiscation, Expropriation, Nationalization
- Currency Risks
- Natural Disasters
- Fuel Risks
  - Lack of Availability
  - Does Not Match Design Fuel



## ► Republic of Indonesia

- Perusahaan Listrik Negara (PLN) National Utility
- Military Dictatorship (Benevolent) until 1999
- Local Currency – Rupiah (Not highly Valued)
- Natural Resources
  - Oil – Extremely high quality crude
  - Natural Gas (late 1980's)
  - Bauxite/Alumina
  - Agricultural/Timber
  - Coal (late 1980's)
- Manufacturing
  - Cement
  - Textile and Clothing
  - Light Industrial





## ► Four Power Projects Developed from 1975- 2000

- Semarang Steam Power Plant Units 1 and 2 (1975-80)
  - 2 x 50 MW Heavy Oil Fired Steam Thermal
  - Central Java
- Muara Karang Steam Power Plant Unit 4 and 5 (1978-84)
  - 2 x 200 MW Heavy Oil Fired Steam Thermal
  - Central Java
- Suralaya Steam Power Plant Units 5,6, and 7 (1989-97)
  - 3 x 700 MW Pulverized Coal
  - West Java
- Paiton Units 5 and 6 (1996-2002)
  - 2 x 660 MW Pulverized Coal with Sea Water FGD
  - East Java



## ▶ Semarang Steam Power Plant Units 1 and 2

- Feasibility Study, Phase 1 engineering funded by USAID
- Phase 2 Engineering (Detailed Design), Major Equipment (Boilers, Steam Turbines, Electrical) funded by USAID. Engineer and Suppliers all US.
- Site Development funded by Indonesian Government (included fuel storage)
- Civil/Structural Construction funded by Indonesian Government
- Mechanical/Electrical Construction funded by USAID
- Project Completed in 1980
- USAID Funding backed by Sovereign Guarantee from Indonesian Government



## ▶ Maura Karang Steam Power Plant Units 4 and 5

- Feasibility and Phase 1 Engineering funded by Asian Development Bank (ADB)
- Phase 2 Engineering funded by World Bank (IBRD)
- Major Equipment (Boilers, Turbines, Transformers, Electrical Equipment) funded by World Bank (IBRD)
- Site Development (including Fuel Storage) funded by Indonesian Government
- Civil/Structural Construction funded by Indonesian Government
- Mechanical/Electrical Construction funded by World Bank (IBRD)
- Transmission Line and Substation Development funded by Asian Development Bank (ADB)
- Project Completed 1983
- World Bank Funding backed by Sovereign Guarantee from Indonesian Government.



## ► Suralaya Steam Power Plant Units 5,6, and 7

- Feasibility, FEED, and Phase 1 Engineering, Interface Engineering Funded by IBRD-Project Broken into Turnkey Islands
- Boiler Island – Three boilers plus auxiliary equipment, including piping and electrical. Funded by Syndicate of Canadian Banks plus Canada Ex/Im.
- Turbine Island – Three steam turbines and auxiliaries, including piping and electrical. Funded by Japan Ex/Im plus supplier financing from Japanese trading company.
- Ash Handling Island – Indonesian Government Funding
- Civil/Structural Construction – Indonesian Government Funding
- Mechanical/Electrical Construction – World Bank (IBRD) Funding
- Coal Handling Island – Commercial Bank Financing
- Project Completed 1997
- Sovereign Guarantee for Portion of Project



## ▶ Paiton Private Power Project 2 (Units 5 and 6)

- Project Performed as an EPC (Lump Sum Turnkey) to Be Owned and Operated by PT Jawa Power.
- Project Development as a Independent Power Producer (IPP) by Siemens Power Ventures
- Three Party Consortium
  - Siemens – Provided Steam Turbines and all Electrical Equipment
  - ABB – Provided all Boiler and Auxiliary Equipment, plus AQCS, Coal Handling, and Ash Handling
  - Black & Veatch – Provided all Detailed Engineering, procurement of all BOP equipment, civil, mechanical, and electrical construction.
- Commercial Financing Obtained by Siemens Power Ventures:
  - US Export Import Bank
  - Hermes (German Export Credit Guarantee)
  - German Kreditanstaltstueferwiederaufbau (KfW)
  - C&L Deutsche Revision (German Public Investment Insurance agency)



## ▶ Coal Fueled Technology is Evolving

- IGCC Still in Infancy
- Circulating Fluidized Bed growing in Capacity. Single Combustor of 330 MW practical
- AQCS for Conventional PC Units increasing in Complexity

## ▶ Project Finance is Evolving

- Sovereign Guarantees scrutinized more since Asian currency crisis
- Some Institutional Lenders reluctant to go too far
- Commercial Financing more difficult to obtain
- BOT Financed Projects are becoming more prevalent
- Problem Countries of the past making it difficult for Everyone