Human Resource Development for the Proposed 9.6 GW Nuclear Build Programme in South Africa

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Background

- Population ~ 51.8 million
- 7.7 million people **still** do not have access to mains electricity
- 2010-30 Integrated Resource Plan for Electricity (revised 2014)
  - 9.6 GW of new capacity from nuclear power
Integrated Resource Plan for Electricity (IRP) 2010 - 30 revised 2014

Gigawatts

- Renewables inc. Solar, PV, CSP, Wind: 3.9 gigawatts
- Nuclear: 17.8 gigawatts
- Coal: 9.6 gigawatts
- Hydro: 6.3 gigawatts
- Gas - Closed cycle gas turbines: 2.6 gigawatts
- Gas - Open cycle gas turbines: 2.4 gigawatts
Loss of skills

25,000 skilled professionals will retire from US nuclear industry by 2015 – NEI Report 2011
Dimensions of the task

- How long is a piece of string?

- Necessary to develop a number of assumptions to assist in putting numbers and costs to the project

- 2013 The Nuclear Industry Association of South Africa published “NIASA Educational Sub-Committee Report on Skills Requirements for the Proposed Nuclear Build Programme”
Assumptions

1. New Build will consist of 9.6 GW

2. Four reactors to be built at one site – Thyspunt with common management & two reactors will be built at Koeberg (the existing site of npp) but with separate management

3. Fleet will start as EPC contract moving to a EPCM contract by fifth unit (increasing localisation upto 40%)

4. No legal challenges/delays

5. Eskom will be owner/operator

6. Nuclear reactor technology neutral – no preferred vendor currently selected

7. Schedule is as follows;
# Construction Schedule – 9.6 GW (six units)

| Number of Unit | Capacity MW | Commissioning year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|----------------|-------------|---------------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|
| 1              | 1600        | 12                  | ✅ |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |
| 2              | 1600        | 13                  |   | ✅ |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |
| 3              | 1600        | 14                  |   |   | ✅ |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |
| 4              | 1600        | 15                  |   |   |   | ✅ |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |
| 5              | 1600        | 17                  |   |   |   |   | ✅ |   |   |   |   |    |    |    |    |    |    |    |    |    |    |
| 6              | 1600        | 18                  |   |   |   |   |   | ✅ |   |   |   |    |    |    |    |    |    |    |    |    |    |

- Yellow: Pre-project, planning
- Orange: Site preparation
- Green: Construction
- Blue: Commissioning & testing
- Pink: Operation
Number of units under construction at any point in project

Peak labour requirements will be from years 9 – 12 of construction project
Adjusted construction labour requirements in South Africa

- South Africa has always had a traditional work practice that has been labour-intensive rather than capital-intensive.

- In developing meaningful labour numbers this needs to be reflected in calculations based on OECD/US labour numbers

- **Regional multiplier of 2.15 developed**
SA’s construction labour requirements

- Using US DoE figures* for construction of 1000 MW PWR-type unit and assuming for every five construction jobs there is an additional one support member and adjusted with regional multiplier, it is estimated peak on-site labour numbers per unit under construction will be in the order of 5630 personnel. This includes ‘balance of plant systems (BOP)’. BOP systems include warehouses, water treatment systems, admin buildings etc.

Peak ‘On-site’ labour requirements – single 1000 MW PWR-type unit

<table>
<thead>
<tr>
<th>Job Type</th>
<th>Peak average personnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Craft labour – artisans &amp; technicians</td>
<td>4140</td>
</tr>
<tr>
<td>Craft supervision</td>
<td>210</td>
</tr>
<tr>
<td>Site indirect labour</td>
<td>410</td>
</tr>
<tr>
<td>Quality control inspectors</td>
<td>100</td>
</tr>
<tr>
<td>NSSS Vendor and subcontractor staff</td>
<td>360</td>
</tr>
<tr>
<td>EPC Contractor’s managers, engineers and Schedulers</td>
<td>260</td>
</tr>
<tr>
<td>Start-up personnel</td>
<td>150</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5630</strong></td>
</tr>
</tbody>
</table>
Projected Staffing Numbers

Year of project

Staffing numbers

0 5000 10000 15000 20000 25000 30000

Total non-graduate level staffing requirements/year
Total Graduate Level Staffing requirements/year

UNIVERSITY OF THE WITWATERLAND
Johannesburg
Graduate staffing needs

Graduate staff required for construction project

Number of staff needed

Year of construction project

[Bar chart showing the number of staff needed for construction projects across different years, categorized by role: Engineers, Scientists & other professionals, Planners, Project manageres.]
Non-graduate staffing needs

Non-graduate staff requirements for construction project

Year of project

Numbers of people needed

- Others
- Technicians
- Instructors
- Security
- Artisans
Breakdown of required Artisanal Skills

- Truck drivers: 4%
- Boilermakers: 4%
- Sheetmetal workers: 4%
- Pipefitters: 19%
- Carpenters: 11%
- Electricians/Instrumentation: 20%
- Iron workers/Fitters/Welders: 20%
- Operating engineers/ Crane operators: 9%
- Painters: 2%
- Millwrights: 3%
- Masons: 2%
- Insulators/Thermal insulators: 2%
Operating and maintenance staff for the new npp's

Utility Operation & Maintenance jobs for a 9600 MW fleet of NPPs

Minimum time needed to "grow" a professional

Year

Actions

Utility Operation & Maintenance jobs for a 9600 MW fleet of NPPs

Minimum time needed to "grow" a professional
Two clear educational streams required

- Graduate level – engineers, scientists, and senior/middle management
- Artisanal/Technical level – craftsmen responsible for the actual construction of the plants
Annual training requirements

Annual training requirements graduate/non-graduate staff

Numbers of staff trained - graduates
Numbers of staff trained - non-graduates

Year of construction project

Total Graduate Level Staff training requirements/year
Total non-graduate level staffing requirements/year
Graduate level education

- University of the Witwatersrand – graduate & undergraduate programmes
- Northwest University – postgraduate programmes
- Pretoria University – postgraduate programmes
- University of Cape Town – postgraduate programme
- University of Johannesburg – postgraduate programme
Technical/Artisanal Training

- Critical shortage of FET places, experiential training, and apprenticeships – issue that doesn’t only effect South Africa
- Eskom
- Necsa
- Further Education Colleges???
Summary

- Universities can probably produce the required numbers of graduates on time, provided they start developing them now.

- Technical/artisanal training requires significant work to develop the necessary capacity to develop/grow the local skills base necessary to bring the project to completion on time and within budget.