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Human Resource Development For The Proposed 9.6 GW Nuclear Build Programme In South Africa

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Abstract: The South African Government has identified the need to install new power generation capacity if it is to maintain the growth of the country. As part of this increase capacity, it has been proposed that 9.6 GW will come from new nuclear power stations to be built at various locations within the country. Like many countries around the world and because there has been no new nuclear power stations constructed, South Africa has seen the decline in the numbers of people who have the necessary nuclear skills to build, commission, operate and finally decommission a nuclear power station. To this end a number of academic institutes have put forward plans to enlarge or even develop from new, various courses and training programmes. To meet this need for such qualified individuals this paper will consider a number of different solutions that have been proposed and developed to train and educate individuals for entry into the nuclear new build programme.

1. Introduction

South Africa is a country with a population of 51.8 million people, of which 7.7 million people still do not have access to mains electricity. In order to address this issue and the need for the country to continue to develop its industrial capacity, the government of South Africa produced the Integrated Resource Plan for Electricity 2010-2030 (IRP) [1] The document recommends a number of power generation options including the construction of an additional 9.6 GW of nuclear power generation capacity. This paper will have a look at some of the consequences of this decision for the country. Particularly the need to educate, train and, develop new staff to populate the desired nuclear construction programme.

South Africa along with much of the world has seen its stock of 'nuclear professionals' decline, for very much the same reasons as elsewhere in the world, namely lack of a continuing nuclear construction programme, retirement and people moving away from the nuclear industry. In a report released in 2010 by Victor and Bharuth-Ram the following numbers and distribution of staff in the South African nuclear industry was reported in Table.1 [2]. As can be seen there is a skewed distribution from what might be considered 'normal' which has a profound effect on the ability of the current workforce to bring such a mega-capital project to completion. More than 70% of the current working population in the nuclear industry hadn't even started their career when the second unit at Koeberg nuclear power station was synchronised to the national power grid in South Africa.

Table 1 *Age distribution of the SA nuclear workforce 2010 [2]*

Age Range	20-29	30-39	40-49	50-59	60-69
Percentage	19	31	25	20	4

In order then to meet this shortfall in adequately prepared staff, the country is in the process of putting a number of plans into place to develop suitably qualified individuals who will be capable of working in the nuclear arena. These plans include people both at a professional level but also those people who will work at an artisan/technician level.

2. Dimensions of the task

Before any sort of meaningful response to the need for training and education of staff can be developed, it is necessary to get a detailed view of what is going to be required in terms of numbers of adequately qualified people capable of participating in a construction project of the size contemplated in the IRP. To this end, the Nuclear Industry Association of South Africa (NIASA) have commissioned a number of reports, culminating in the release of the Niasa Educational Sub-Committee Report on Skills Requirements for the Proposed Nuclear Build Programme [3]. This document, drawing from the experiences of a number of countries and organisations tries to put figures and financial costs to the number of people that need to be trained and educated. In developing this report that is based on international experience from both the United States and The Organisation for Economic Co-operation and Development (OECD) countries, a number of specific assumptions had to be made about the South African workforce, which reflected prevailing labour-intensive work practices in the country. This has resulted in a need to devise a regional multiplier for the numbers of people required to carry out a range of construction jobs. This value has been put at 2.15. This figure compares favourably with numbers of workforce needed to construct the Daya Bay nuclear power plant built in The Peoples Republic of China [4].

2.1. Adjusted construction labour requirements in South Africa

Using US DoE figures [5] for the construction of a 1000MW Pressurised Water Reactor adjusted for South African conditions, and assuming that for every five on-site construction jobs there will be a need for an additional support staff member, it has been estimated that the peak onsite labour numbers, per unit under construction will be of the order of 5,630 personnel (Table 2).

Table 2 Peak on-site construction labour required for one Gen III type reactor (SA) adjusted [3]

Job Type	**Peak average personnel**
Craft Labour – artisans/technicians	4140
Craft Supervision	210
Site indirect labour	410
Quality control inspectors	100
NSSS Vendor and subcontractor staff	360
EPC Contractor's managers, engineers and schedulers	260
Start-up personnel	150
Total	**5630**

Table 2 considers the labour requirements for a single unit; if however one contemplates the entire project lifecycle then Fig 1 gives the overall staffing requirements, divided into graduate and non-graduate categories. As can be seen the artisan/technician numbers greatly exceeds graduate numbers indicating where most of the training and education efforts need to be concentrated.

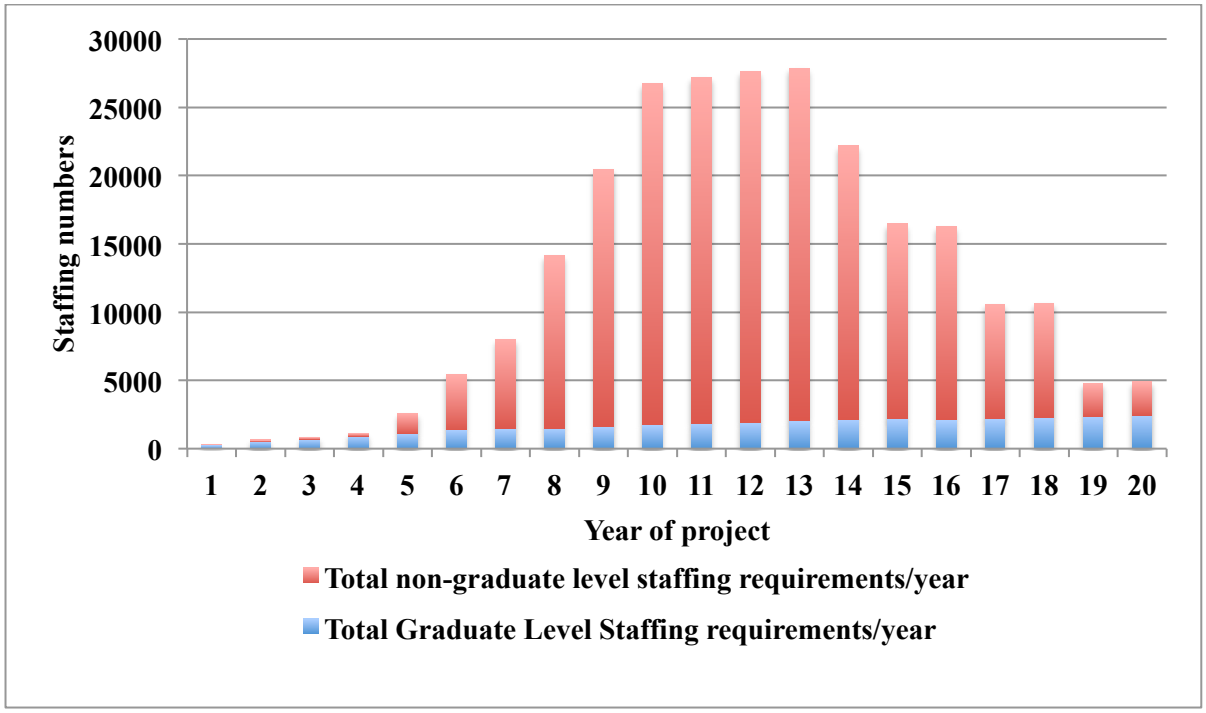

Figure 1 *Total labour requirements for construction of six Gen III type PWR units*

The figures show an increase from year five when construction of the first unit begins, until year ten when construction of the fourth unit begins, there after there is an decrease in numbers as each unit moves into the commissioning/testing phase and finally into commercial operation. There will be a steady increase in the numbers of people requiring training and education as each of the first four units begins construction, but then when units five and six start construction there will be an additional increase in training numbers as these units will be built in a different geographical location to units one – four and much of the artisanal/technical workforce will be unwilling to relocate to the new region. Years three and four become critical for graduate education, as the project requires an additional 200 people per year. Years five – ten see the annual need for additional non-graduate staff rise from 1000 to 6000 people per year! This will have a very significant impact on the further education establishments within the regions of the nuclear power stations construction.

3. Training and Educational Initiatives to meet forecast demand

It can be seen then that there are two very clearly defined educational streams that need to be developed, resourced and maintained if this ambitious construction project of six units is to be achieved: the graduate level producing the engineers, scientists and senior and middle level management, and the artisanal/technician level, the craftsmen responsible for the actual construction of the power station units.

3.1. Graduate level Educational Programmes

A number of universities within South Africa have taken actions to assist in the development of the required graduate level entrants into the nuclear industry. The principal one's being University of the Witwatersrand (Wits),Johannesburg, North West University, University of Cape Town and Johannesburg University, all of whom have either electives in the nuclear arena or full postgraduate programmes in various nuclear related disciplines. Wits University is alone in having an undergraduate programme in nuclear science and engineering. Several Technikons (Universities of Technology) offer courses for technicians in the field of instrumentation.

3.2. Non-graduate level Educational Programmes

At the moment this is an area of significant concern, as for many years the Colleges of Further Education, the places were traditionally the artisans and technicians received their training and education have fallen behind. More and more of South Africa's youth have chosen to go to university rather than taken a vocational qualification as they believe that there are better career and financial prospects after completing their education. This is certainly borne out by the statistics. The overall unemployment rate is currently running at 24.1 % whereas graduate unemployment is below 6%.

Niasa is currently engaging with various training organisations, particularly in the Eastern Cape, the region in which the first of the new nuclear power stations is to be built, to try and assist in the development of the necessary training expertise necessary to produce the large numbers of artisans that will be required there.

4. Conclusion

It is recognised that there are still large numbers of people to be adequately qualified to take part in the new build programme, this being understood various organisations within the country are taking active steps to rectify this situation, so that when the final decision is taken to 'go nuclear' the country will be well placed to start the project.

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