

Human Resources Requirements For New Nuclear Power Programs

A Presentation To

International Conference on Human Resource Development for Nuclear Power Programmes: Building and Sustaining Capacity

**Strategies for Education and Training,
Networking and Knowledge Management**

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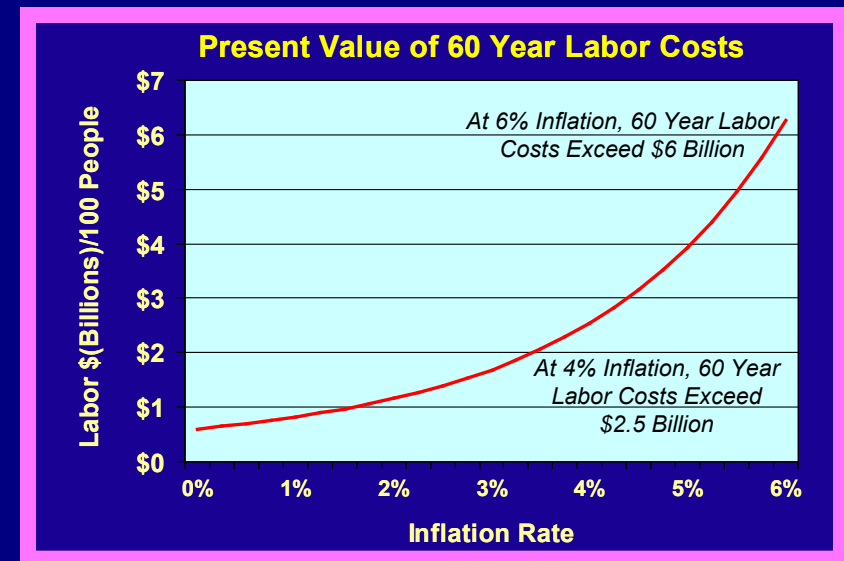
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Labor Costs Will Be A Very Large Element Of Nuclear Plant Life Cycle Costs

- Most companies considering construction of new nuclear power plants focus on the initial construction costs (i.e. cost/installed kw, expected to be Billions of \$USD), however total labor costs may be a higher value
- For companies not currently considering new construction, License Renewal adding 20+ years must also consider long-term labor costs
- In the USA, typical fully burdened labor costs are ~\$100,000 per person per year
- Thus, every 100 people = \$10 M/year
- *Assuming a 60 year life cycle for a new plant and a 4% average inflation rate, 100 personnel will cost over \$2.5 Billion*



5 Key Issue Areas Must Be Analyzed For Major Nuclear Plant Activity Areas

- The 5 key issues impacting human resources requirements for a new nuclear power plant (NPP) are:
 - Plant Design*
 - Site Layout*
 - Regulatory Requirements*
 - Outsourcing*
 - Centralization*

- The activities at an NPP, and the associated supporting programs, can be grouped into five Areas, creating an analysis matrix:

- *Operations*
- *Engineering*
- *Maintenance*
- *Regulatory*
- *Site Support*

Area	Plant Design	Site Layout	Regulatory Requirement	Outsourcing	Centralization
Operations					
Engineering					
Maintenance					
Regulatory					
Site Support					

- Within each of the five Areas there are several Functions, each with its own set of activities - an overview is presented on the following pages...

Human Resources Requirements In The *Operations* Area

Area	Function	Plant Design	Site Layout	Regulatory Requirement	Outsourcing	Centralization
Operations	Applied Radiation Protection	X		X	X	X
	ALARA/Radiological Engineering	X		X		X
	Chemistry	X		X		
	Decontamination/Radwaste Processing	X		X	X	
	Environmental		X	X	X	X
	Fire Protection	X	X	X		
	Operations	X	X	X		
	Operations Support	X	X			
	Radiation Protection Support			X	X	X

- **Human resources requirements in the *Operations Area* are heavily driven by plant design and regulatory requirements**
- **For example – *Plant Design*:** All shift operators, which comprise the Operations Function, will have tasks and activities dictated by the design of the plant. The configuration and equipment in the Control Room, along with regulatory and emergency response requirements, will determine the minimum number of qualified operators in the Control Room. Additionally, the physical arrangement of the plant's systems and components that require physical monitoring will determine how long it takes an operator to complete one rotation, or "round" of assigned monitoring areas.

Human Resources Requirements In The *Engineering* Area

Area	Function	Plant Design	Site Layout	Regulatory Requirement	Outsourcing	Centralization
Engineering	Computer Engineering	X	X	X		X
	Design/Drafting	X	X	X	X	X
	Modifications Engineering	X	X	X	X	X
	Nuclear Fuels	X	X	X	X	X
	Plant Engineering	X	X			
	Procurement Engineering			X	X	X
	Project Management				X	X
	Reactor Engineering	X	X	X		
	Technical Engineering	X	X		X	X

- Human resources requirements in the *Engineering Area* are heavily driven by plant design, site layout, and regulatory requirements
- For example – *Site Layout*: The site layout affects the staffing levels of most of the functions in the Engineering Area due to the interconnection of systems and components. Specifically, piping and cabling within and among structures and buildings include many technical attributes that require engineering support, including much of the design basis of the plant. the structures), fall within several of the Engineering Area functions. Intake and cooling structures which require engineering technical support may vary due to site selection, and therefore require variances in engineering staffing.

*Several functional areas may be centralized
in multi-unit or multi-site operations*

Human Resources Requirements In The *Maintenance* Area

Area	Function	Plant Design	Site Layout	Regulatory Requirement	Outsourcing	Centralization
Maintenance	Facilities Maintenance		X		X	X
	Maintenance/Construction	X	X	X	X	
	Maintenance/Construction Support	X	X	X	X	
	Outage Management	X	X	X		
	Quality Control/Non-Destructive Examination			X	?	X
	Safety/Health	X		X		X
	Scheduling	X				

- Human resources requirements in the *Maintenance Area* are also heavily driven by plant design, site layout, and regulatory requirements
- For example – ***Regulatory Requirement***: Requirements may apply to maintaining and analyzing maintenance histories for certain types of specified equipment. In the United States, the Nuclear Regulatory Commission implemented the Maintenance Rule program (10 CFR 50.65, in 1996) with these types of requirements, which increased the scope of work with the Maintenance/Construction Support Function. Furthermore, if the regulatory body specifies maximum work hour rules, additional personnel may be required depending on the rotation and duration of maintenance shifts.

Human Resources Requirements In The *Regulatory* Area

Area	Function	Plant Design	Site Layout	Regulatory Requirement	Outsourcing	Centralization
Regulatory	Emergency Preparedness	X	X	X		X
	Licensing	X		X		X
	Nuclear Safety Review			X		X
	Quality Assurance			X	?	X
	Security	X	X	X	X	X

- **Human resources requirements in the *Regulatory Area* are also heavily driven by plant design, site layout, and regulatory requirements**
- **For example – *Regulatory Requirement*:** Requirements will apply how physical security is provided for the NPP site, and normally include restricted access via roadways, rail lines, water access, as well as for authorized personnel access. These requirements are normally determined at the national level, and vary significantly depending on degree of isolation of the NPP, as well as perceived threat levels. More detailed security staffing requirements are determined by site physical layouts such as location of fences and buildings, line-of-site access, early warning detection system locations, etc.

Human Resources Requirements In The *Site Support* Area

Area	Function	Plant Design	Site Layout	Regulatory Requirement	Outsourcing	Centralization
Site Support	Budget/Accounting			X		X
	Communications			X		X
	Contracts				X	X
	Document Control/Records				X	X
	Human Resources					X
	Information Management				X	X
	Management			X		
	Management Support					
	Materials Management	X			X	X
	Purchasing				X	X
	Training		X	X		X
	Warehouse	X	X		X	X

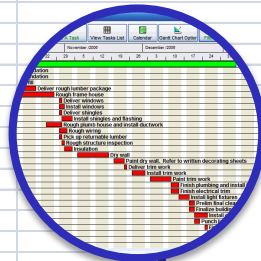
- **Human resources requirements in the *Site Support Area* are more driven by approaches and decisions of the NPP operating organization**
- **For example – *Centralization***: The NPP Operating organization will make decisions about the level of support that will be provided to the technical organizations, i.e., how much IT support is appropriate, whether or not there are few or many HR representatives on site, is the supply chain process centralized with other electric generation assets, etc.

To Optimize Human Resources (and Costs), Each Highlighted Area Of The Matrix Must Be Analyzed

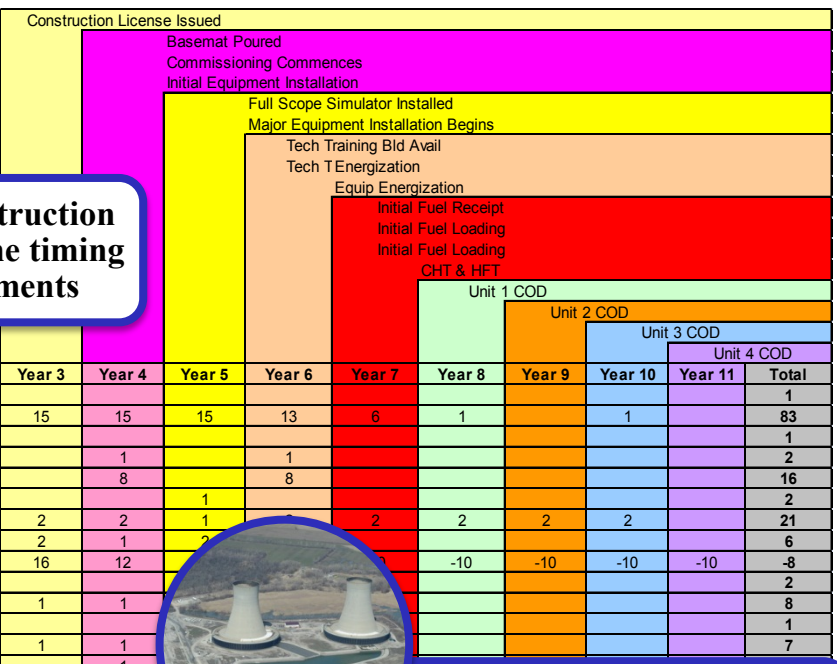
- This Staffing Requirements Matrix summarizes the complexity and breadth of analyzing and planning for human resources development for a new nuclear power plant
- Each area must be analyzed for it impacts on human resources requirements
- Those requirements will determine the hiring lead times and necessary training programs

Area	Function	Plant Design	Site Layout	Regulatory Requirement	Outsourcing	Centralization
Operations	Applied Radiation Protection	X		X	X	X
	ALARA/Radiological Engineering	X		X		X
	Chemistry	X		X		
	Decontamination/Radwaste Processing	X		X	X	
	Environmental		X	X	X	X
	Fire Protection	X	X	X		
	Operations	X	X	X		
	Operations Support	X	X			
	Radiation Protection Support			X	X	X
Engineering	Computer Engineering	X	X	X		X
	Design/Drafting	X	X	X	X	X
	Modifications Engineering	X	X	X	X	X
	Nuclear Fuels	X	X	X	X	X
	Plant Engineering	X	X			
	Procurement Engineering			X	X	X
	Project Management				X	X
	Reactor Engineering	X	X	X		
	Technical Engineering	X	X		X	X
Maintenance	Facilities Maintenance		X		X	X
	Maintenance/Construction	X	X	X	X	
	Maintenance/Construction Support	X	X	X	X	
	Outage Management	X	X	X		
	Quality Control/Non-Destructive Examination			X	?	X
	Safety/Health	X		X		X
	Scheduling	X				
Regulatory	Emergency Preparedness	X	X	X		X
	Licensing	X		X		X
	Nuclear Safety Review			X		X
	Quality Assurance			X	?	X
	Security	X	X	X	X	X
Site Support	Budget/Accounting			X		X
	Communications			X		X
	Contracts				X	X
	Document Control/Records				X	X
	Human Resources					X
	Information Management				X	X
	Management			X		
	Management Support					
	Materials Management	X			X	X
	Purchasing				X	X
	Training		X	X		X
Warehouse	X	X		X	X	

Detailed Staffing Plans Must Be Designed To Support Construction Milestones & Lead Times



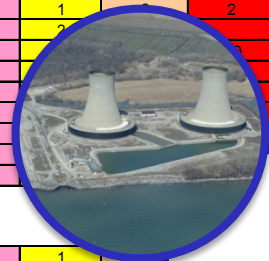
Program and construction milestones drive the timing of staffing requirements



Staffing Function	Job Position	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Total
Admin/Clerical	Admin Supervisor		1										1
	Clerical/Secretarial	1	16	15	15	15	13	6	1		1		83
	Executive/Confidential Assistant	1											1
ALARA	ALARA Supervisor				1		1						2
	ALARA Technician				8		8						16
Budget/Acting	Budget Supervisor	1				1							2
	Budget/Acting Staff	4	2	2	2	1		2	2	2	2		21
Chemistry	Chemistry Supervisor			2	1	2							6
	Chemistry Technician			16	12	2			-10	-10	-10	-10	-8
Communications	Communications Supervisor		1										2
	Communications Staff		1	1	1								8
Contracts	Contracts Supervisor	1											1
	Contracts Staff	3	1	1	1	1							7



Each staffing function must be accounted for (>150 functions)

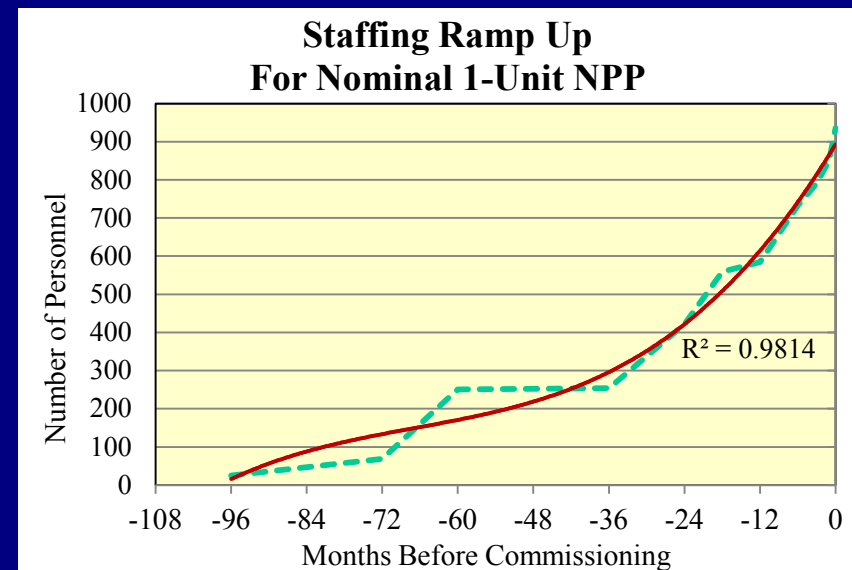


Plans for multiple units complicate requirements

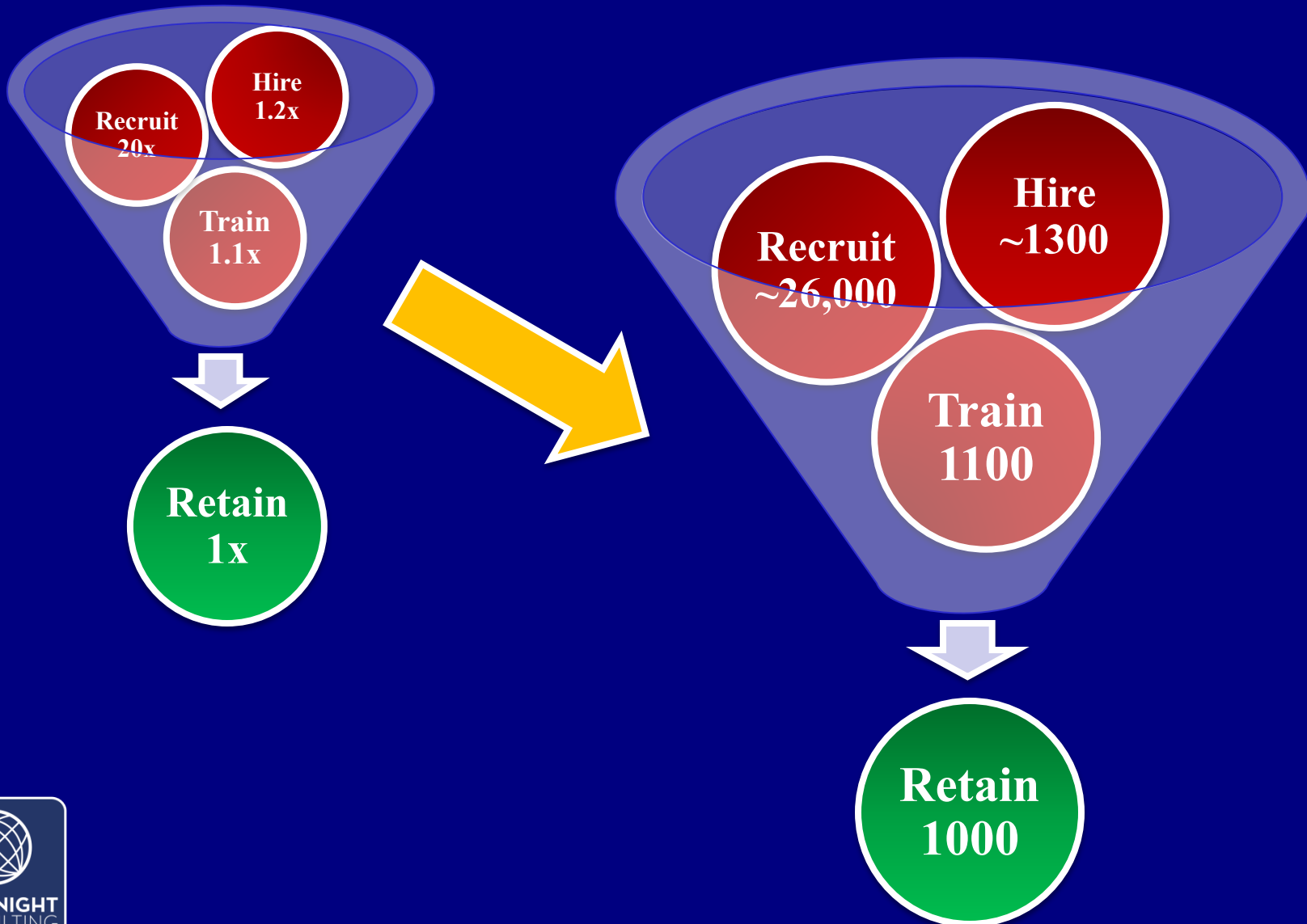
Security	Security Supervisor			1		1							2
	Security Staff			5	1	5	2						13
Training	Training Supervisors (Leads)	3	2										5
	Training Staff	15	25	16	1	7	2						66
Warehouse	Warehouse Supervisor				1		1						2
	Warehouse Staff				5	5	5	5				-1	19
Total		XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX

Lead Times Vary Significantly Depending On The Job Function

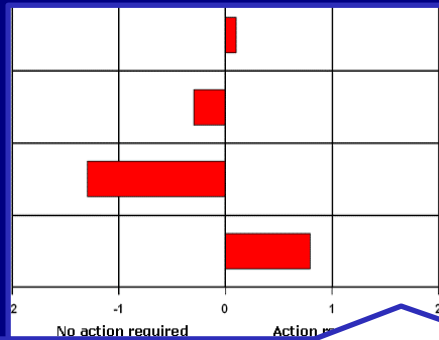
- Lead time requirements for Human Resources vary from a minimum of a few months to 5+ years (See *IAEA Nuclear Energy Series (NG-T-3.10) Workforce Planning for New Nuclear Power Programs, 2011*)
 - *Admin/Clerical (0-3 Months Lead Time)*: Basic computer software competence such as word processing, presentations, etc.
 - *Document Control/Records Management (0-3 Months Lead Time)*: Basic computer competence; understanding of document control and records management
 - *Quality Assurance (6 Year Lead Time)*: Experience in NPP design, operations, maintenance or other nuclear related activities; experience in quality assurance programs and concepts; senior reactor operator license or certification preferred for operations area; design or system engineering experience preferred for engineering area; maintenance or work control experience preferred for the maintenance area.
 - *Nuclear Fuels (5 Year Lead Time)*: Experience in engineering economics or other formal financial experience; nuclear fuel cycle and financial analysis experience.



The Recruiting, Hiring & Training Process Is Typically More Demanding Than Expected



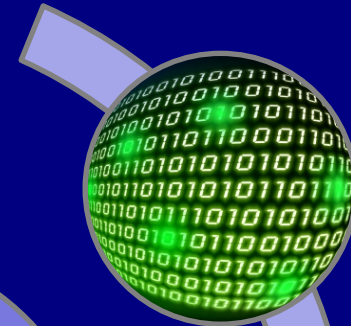
Capacity Building Begins With Identifying Gaps Between Staffing Requirements & National Capability



Quantifying national capacity with a gap analysis will provide:

- understanding of future needs from local academic institutions
- other sources and ensure timely availability of quality personnel

The level of available national resource infrastructure will depend on:



The industrial and technological base and its potential for development



Training and academic institutions



Infrastructure to support non-power applications of nuclear energy

Summary: Planning To Meet HR Requirements For New Nuclear Power Programs Must Begin Early

- Many years of preparation are required before the “Right Number of the Right People” ... will be ... “In the Right Place at the Right Time”
- Seven key steps which must be taken include:
 - 1) Identify detailed Human Resources requirements, based on the selected site and reactor design
 - 2) Conduct an assessment of national capacity to develop and/or provide those resources
 - 3) Conduct a Gap Analysis to determine what additional steps will be needed to fill any capacity shortfalls
 - 4) Develop initial and recurring recruiting and training plans
 - 5) Begin recruiting and training
 - 6) Review and adjust as personnel move and/or leave
 - 7) Ensure adequate relationships are in place for sources of future recruiting

Begin this process about 9-10 years prior to expected reactor commissioning

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**Thank You
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