

Opening Address



Hon Ted O'Brien



Navigating Nuclear UNSW Sydney - 13 May 2024

A one day opportunity to learn everything you need to know about nuclear energy and what it means for Australia's future from global experts.

Closing Address



Dr Adi Paterson

Speakers & Organising Committee



Jaz Diab - Women in Nuclear



Prof Koroush Shirvan - MIT



Prof Jacopo Buongiorno - MIT



Prof Rob Hayes - North Carolina State University



Dr Dave Collins - MIT/PhD UMelb



Prof Simon Michaux - Geological Survey of Finland/PhD UQ



Dr Sarah Lawley - PhD UAdelaide



Mark Nelson - Radiant Energy/UCambridge



Sai Prasad Balla - MIT



Steven Nowakowski - Rainforest Reserves Australia



Helen Cook - GNE Advisory



Dr Ross Koningstein - Google/PhD Stanford



Atte Harjanne - MP Finland Greens/PhD Candidate UAalto



Prof Mike Golay - MIT/PhD CornellU



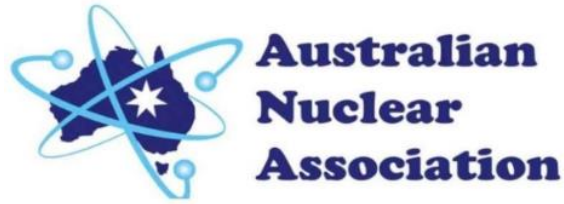
Tony Irwin - ANU



Dr Mark Ho - Australian Nuclear Association



Dr John Harries - Australian Nuclear Association



Organising Committee

Dr Dave Collins (Chair), Dr Mark Ho (President, Australian Nuclear Association), Jasmine Diab (President, Women in Nuclear), Dr John Harries (Secretary, Australian Nuclear Association).

Acknowledgments

Sincere thanks to the following for their support and advice without whom the workshop would not have been possible: Dr Robert Barr, Connor Davies, Prof Julien Epps, Prof Stephen Foster, James Fleay, Tony Irwin, Prof Ed Obbard, Hasliza Omar, Robert Parker, Dr Adi Paterson, Chiara Scalise, Peter Sjoquist, Dr Tim Stone, Prof Peter Tyree, Darka de Vries and the speakers and organising committee.

Chatham House Rules

The Q&As and the Discussion panel were not recorded under the agreed Chatham House Rules.

Speakers & topics

No	Topic	Speakers and affiliation
1	<i>Opening address</i>	<i>Hon Ted O'Brien – Australian Parliament</i>
2	<i>Introduction to Navigating Nuclear</i>	<i>Jasmin Diab – Global Nuclear Security Partners</i>
3	<i>How does nuclear energy work?</i>	<i>Prof Koroush Shirvan - MIT</i>
4	<i>Nuclear energy in the 21st century</i>	<i>Professor Jacopo Buongiorno - MIT</i>
5	<i>Radiological risk in perspective</i>	<i>Professor Robert Hayes - North Carolina State University</i>
6	<i>What would the environmental impacts of nuclear energy in Australia be?</i>	<i>Dr Dave Collins - MIT</i>
7	<i>Challenges and bottlenecks to the green transition</i>	<i>Professor Simon Michaux - Geological Survey of Finland</i>
8	<i>Australia's electricity system</i>	<i>Dr Sarah Lawley - PhD University of Adelaide</i>
9	<i>What is the value of nuclear energy?</i>	<i>Mark Nelson - Radiant Energy Group</i>
10	<i>What happens inside an operating nuclear power plant?</i>	<i>Sai Prasad Balla - MIT</i>
11	<i>Environmental impacts of renewable energy in Queensland</i>	<i>Steven Nowakowski and Jeanette Kemp - Rainforest Reserves Australia</i>
12	<i>Current nuclear energy developments around the world</i>	<i>Helen Cook - GNE Advisory</i>
13	<i>A discovery that nuclear was nonpartisan in the USA</i>	<i>Dr Ross Koningstein - Google</i>
14	<i>How nuclear became green in Finland</i>	<i>Atte Harjanne - Finland Parliament</i>
15	<i>Experience and lessons from creating nuclear safety cultures</i>	<i>Professor Michael Golay - MIT</i>
<i>Not recorded</i>	<i>Discussion panel</i>	<i>Chair: Tony Irwin - ANU</i>
16	<i>Closing address</i>	<i>Dr Adi Paterson – ANSTO (retired)</i>



Navigating Nuclear 2024

What happens inside an operating Nuclear Power Plant?

UNSW Sydney

13 May 2024

Sai Prasad Balla

MIT SDM (MS), Certified Reactor Operator

Presentation layout

- Bio & Motivation
- Nuclear Reactor 101
- Design principles
- Main Control Room overview
- Training

Hometown at a glance

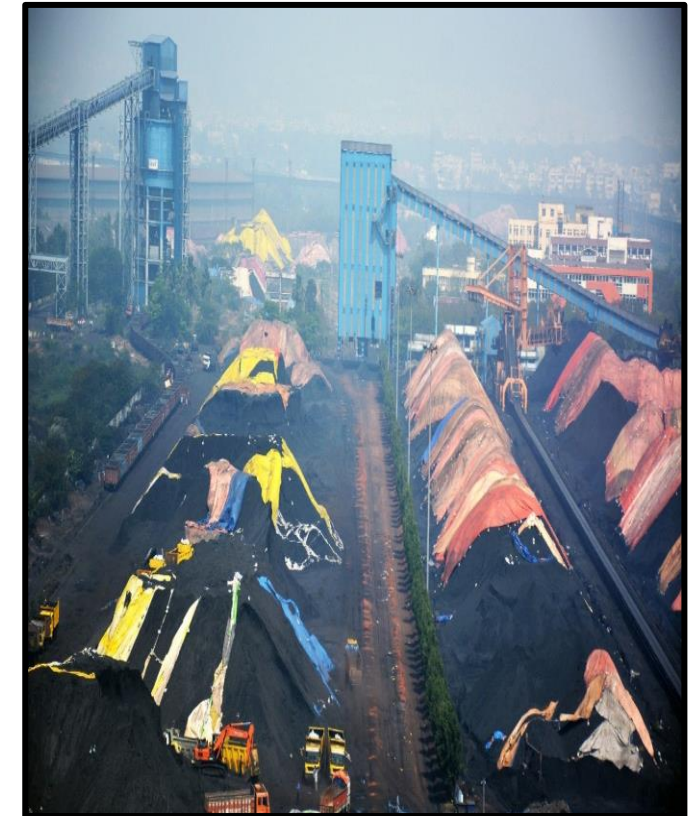
Coal Mines in Korba



Coal Transportation



Coal Handling



Hometown at a glance

Emissions from coal power plant



Ash Bund



Education and training



Education and training



2010	Tarapur NTC (India)	★
2009	BE Mechanical	

Education and training



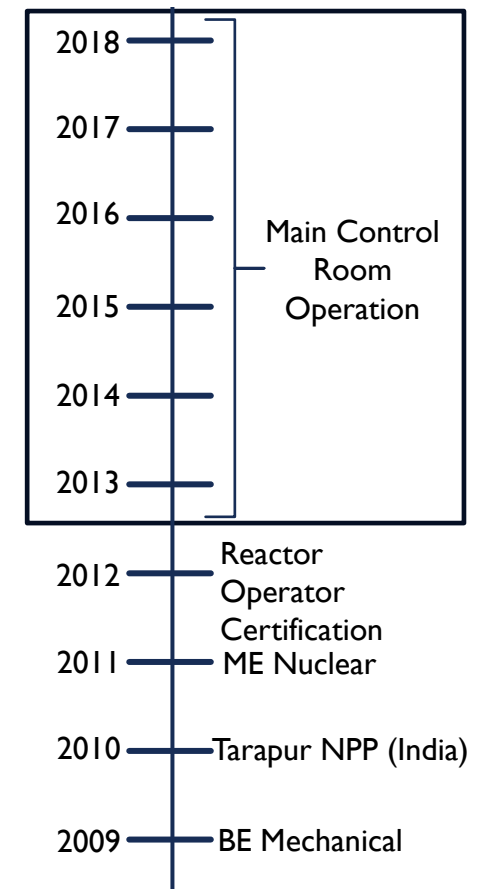
2011	ME Nuclear	★
2010	Tarapur NPP (India)	
2009	BE Mechanical	

Work experience

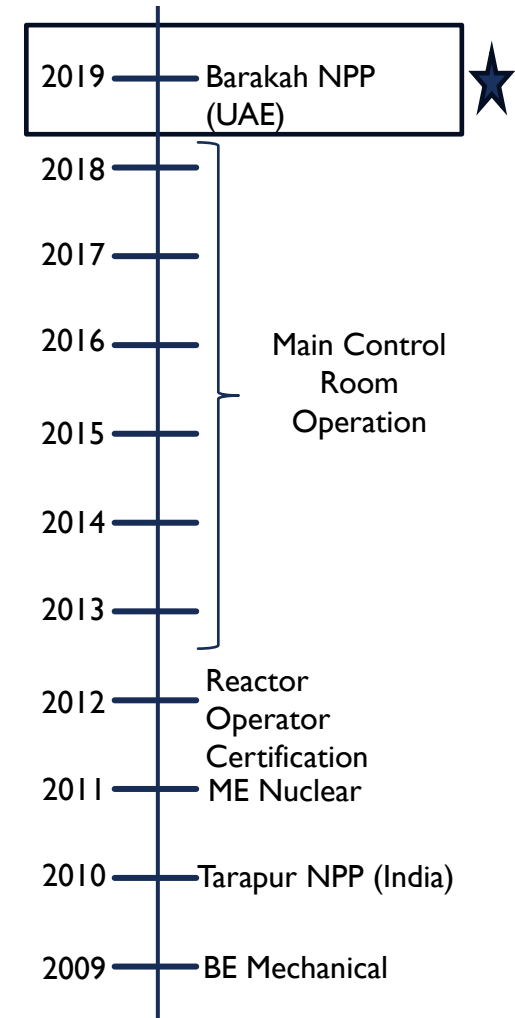


2012	Reactor Operator Certification	★
2011	ME Nuclear	
2010	Tarapur NPP (India)	
2009	BE Mechanical	

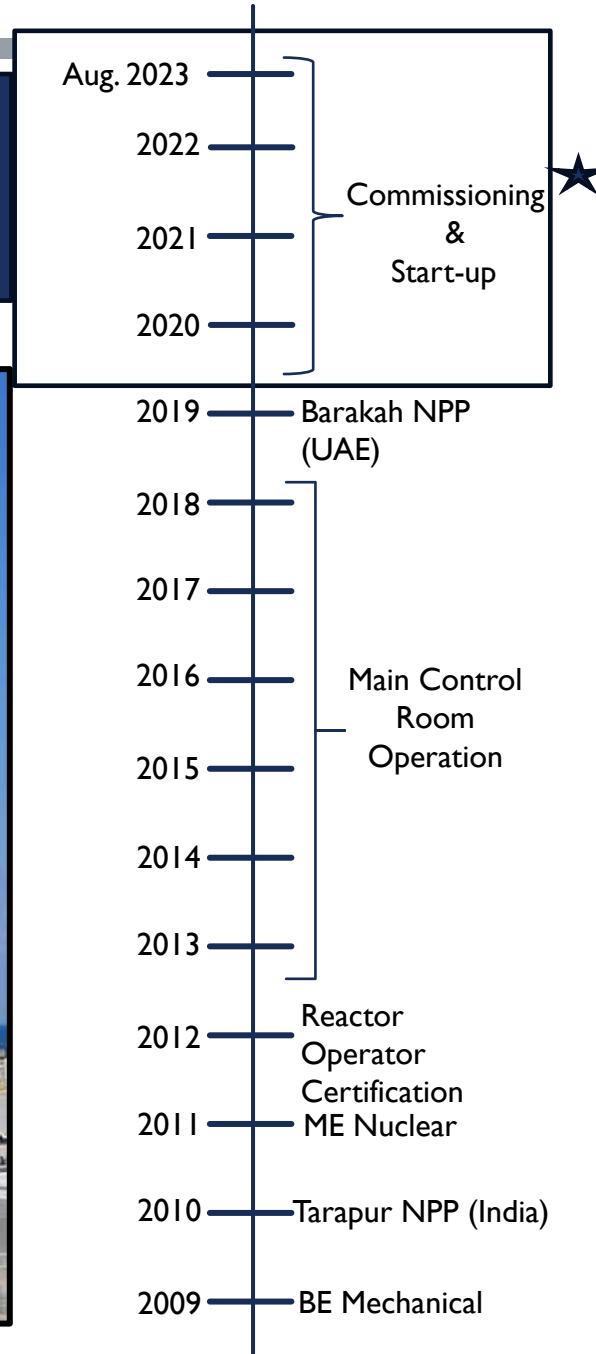
Work experience



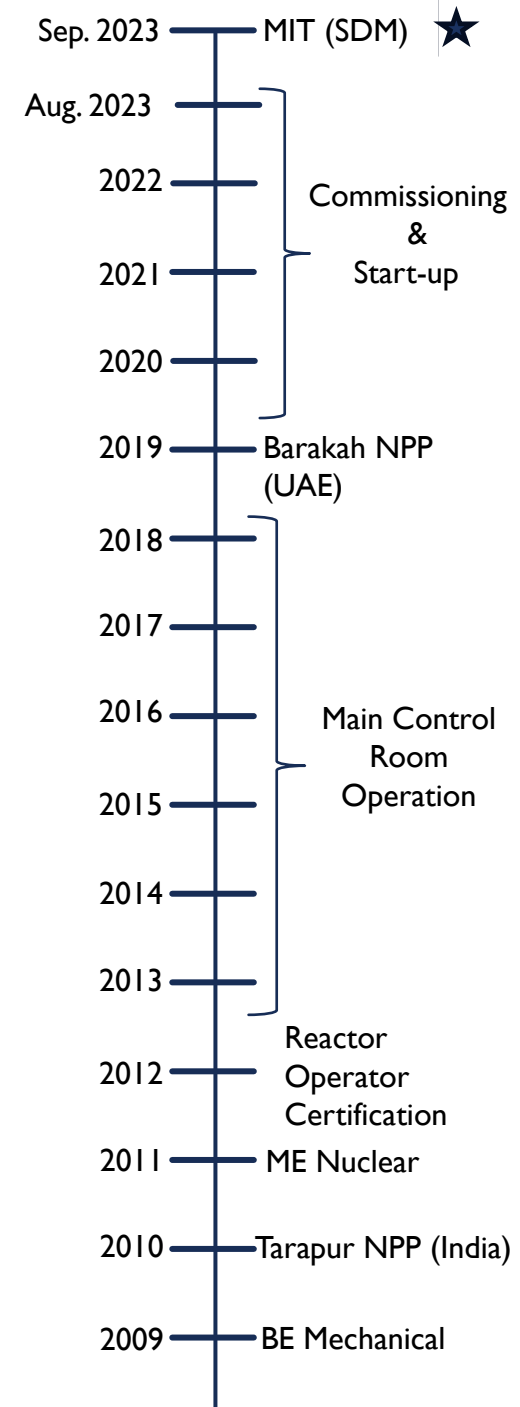
Work experience



Work experience



Current education



What is the source of nuclear energy ?

The source of Nuclear Energy lies in the equivalence of mass and energy according to Einstein's equation:

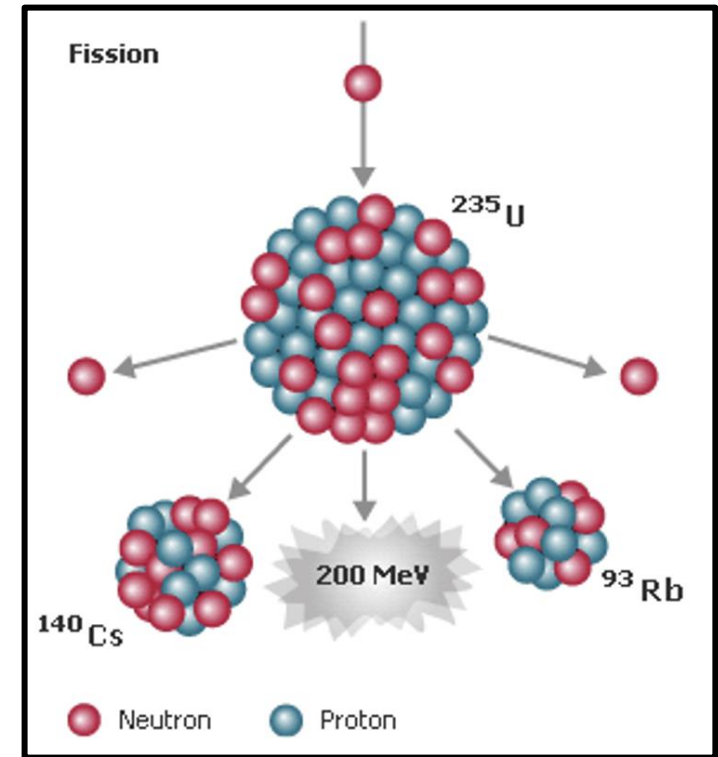
$$E = m c^2$$

where

E is the Energy, Joules

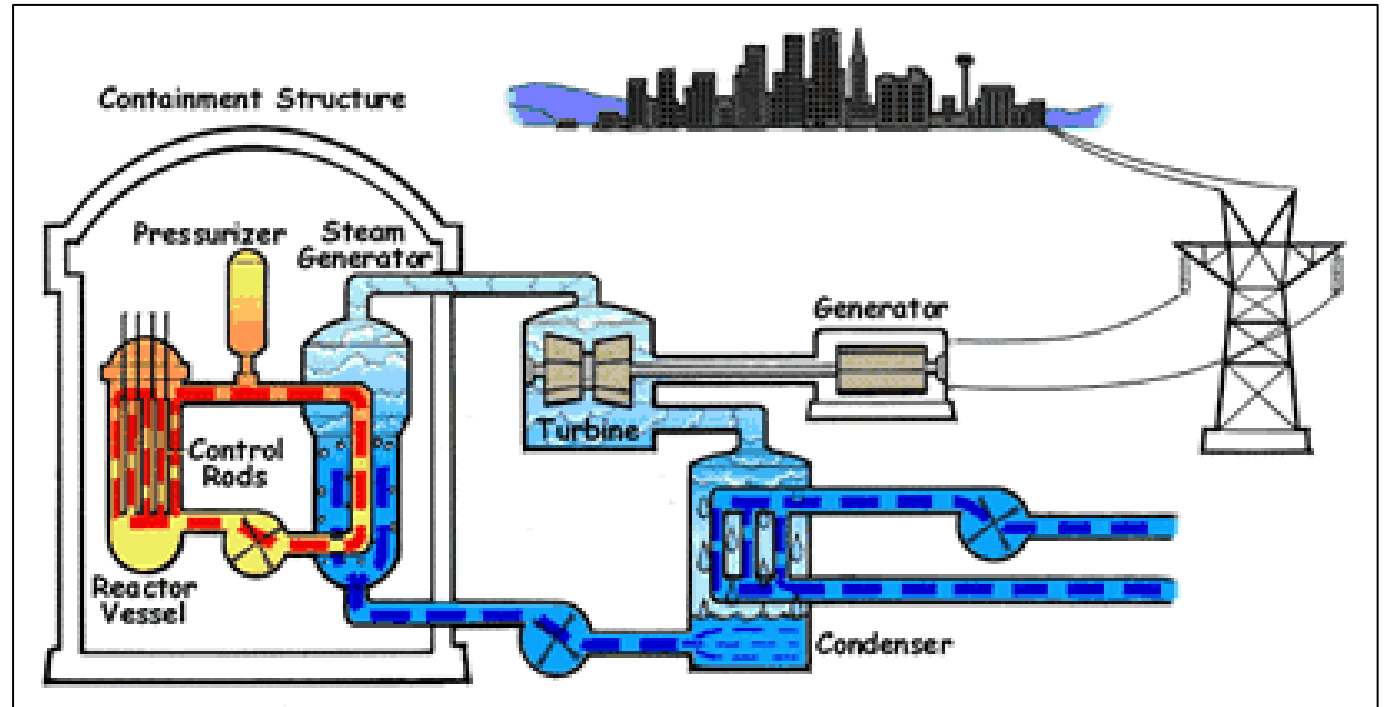
c is the velocity of light, m/s

m is the mass, kg



Nat. U fuel bundle (23.8 kg) is equivalent to 360-400 tons of coal

How does a nuclear power plant work ?



Field view of equipment

Pump Room



Reactor Coolant Pump



Field view of equipment

Generator/ Exciter



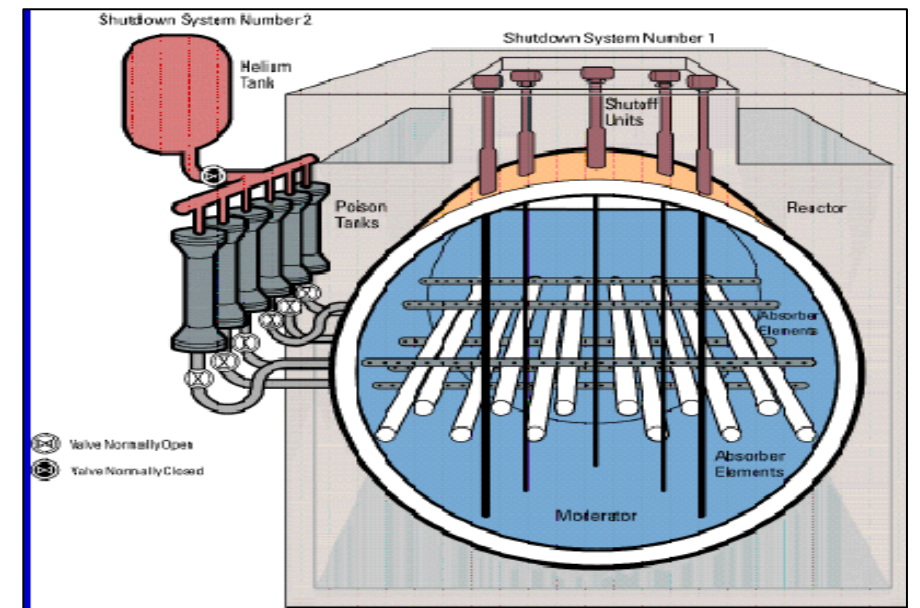
6.6 KV Switchyard



Design principles to ensure safety

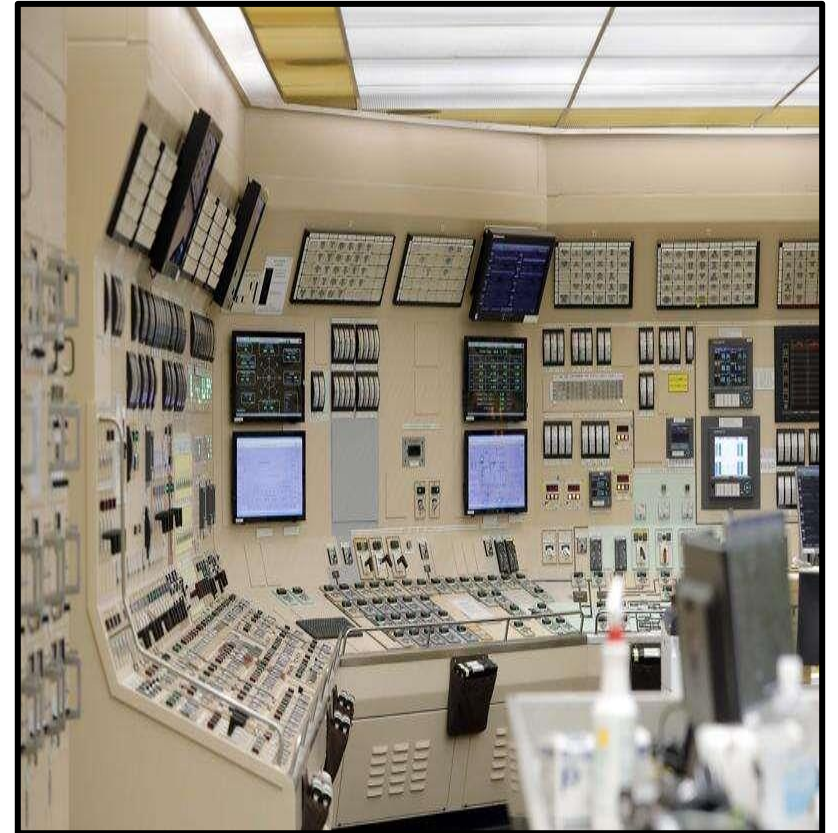
- **Diversity:** Different methods or technologies to achieve the same safety function.
- **Redundancy:** Multiple components that perform the same function.
- **Physical separation:** Components are physically separated.
- **Independence:** Operation of safety systems does not rely on the functioning of other systems.

Principles in action: Shutdown system



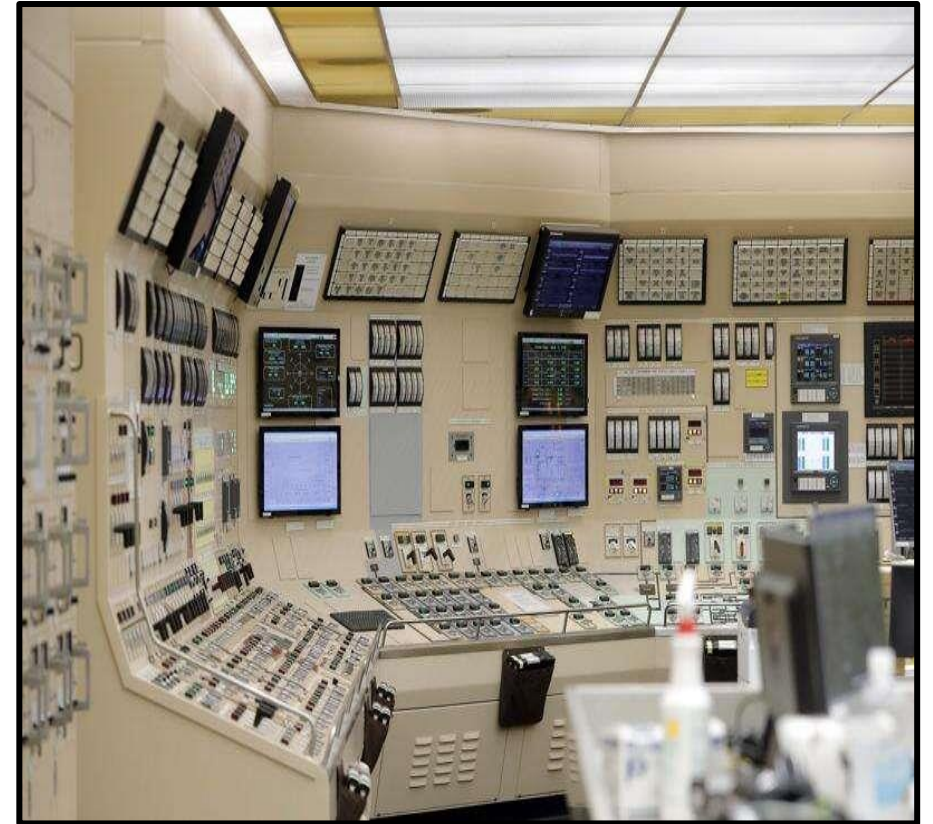
Main Control Room Overview

- Nerve-center to generate electricity safely and efficiently.
- Monitoring and controlling of plant systems.
- Tens of thousands of field values are relayed into MCR.
- Remote video monitoring.

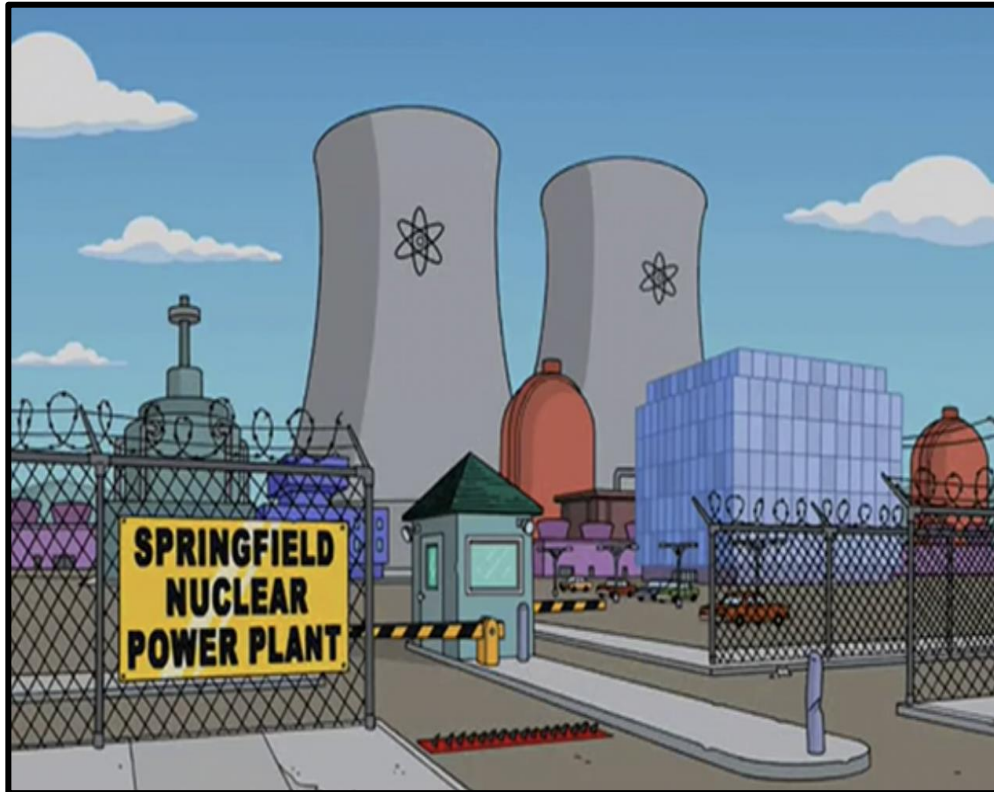


Main control room overview

- Ensuring availability of standby/ passive equipment.
- Start-up of reactor, Shut-down of reactor.
- Alarms indicate system deviation, which requires operator attention. Color-coded for easy identification.
- What if the Main Control Room becomes unavailable?



Similarity with Simpsons?



Rigorous training to become a nuclear plant operator

- Full scope simulator.
- Certified operator Initial training - 2 years training to develop expertise across all sixty systems.
- Certification exam - 70% passing criteria.
- Interview with both senior management and regulators.
- Periodic requalification.
- Continual training - training never stops.



Training is well-rounded, supported by state-of-the-art facilities

Mechanical Shop



Electrical Shop



Power Plant Demonstration



Radiation Physics Shop



Takeaways

- Design principles of nuclear power plants ensure safety.
- As operators, we understand, appreciate, and respect those design limitations during plant operations.
- Training plays a crucial role.
- A challenging yet fulfilling career.



THANK YOU

SAIBALLA@MIT.EDU FOR FURTHER QUERIES/ DOUBTS