Filling the Neutron Gap at CNL after Shutdown of the NRU Reactor

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Chalk River Laboratories is the single largest science and technology laboratory in Canada.

9,100 acres with 200 acres of lab complex

17 nuclear facilities, 70 major buildings

3,100 employees (500 PhDs & Masters)

1,600 engineering, scientific & technical staff

Advanced nuclear fuels and materials research

Radiobiology, radioecology and dosimetry

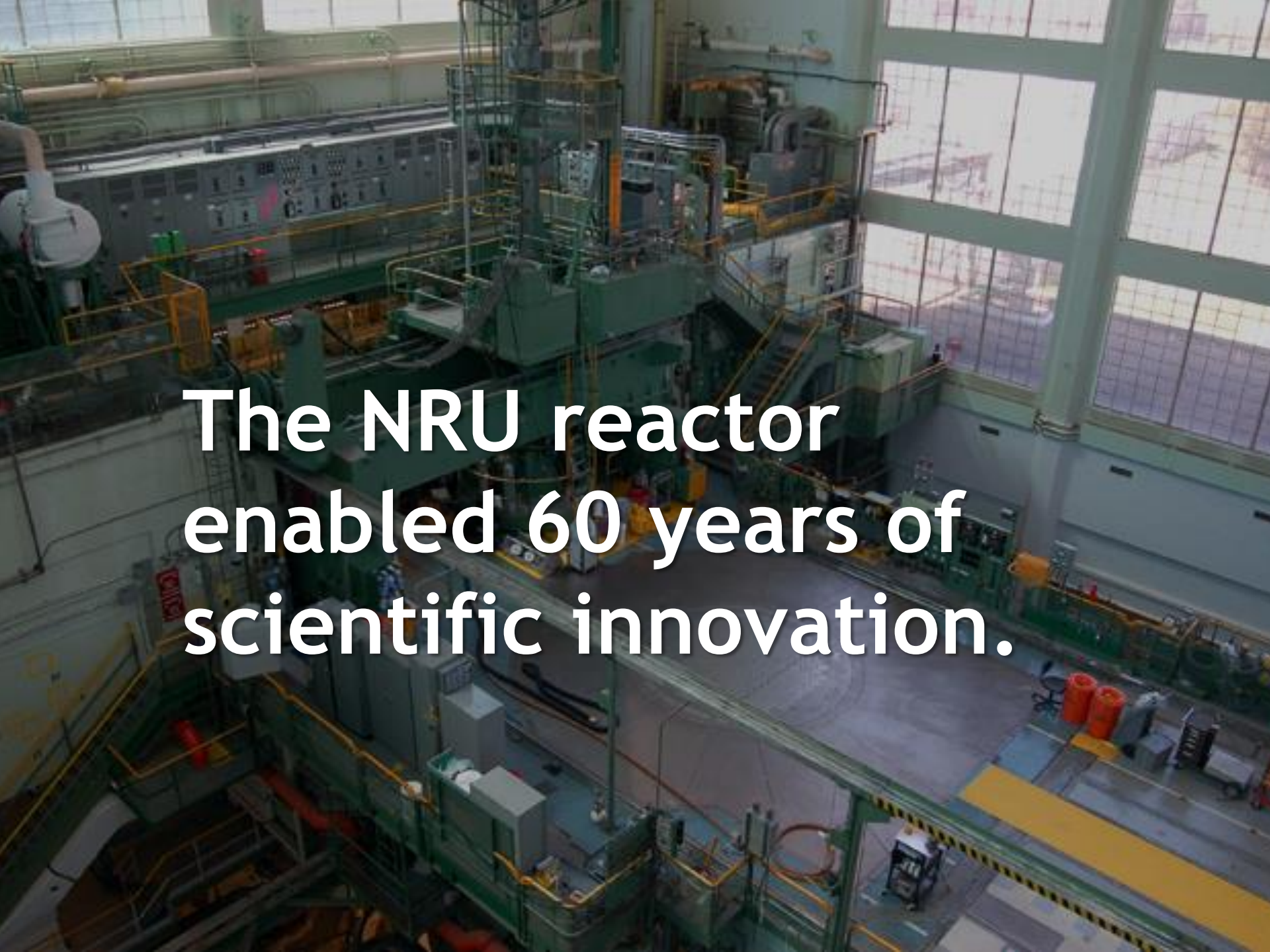
Hydrogen and hydrogen isotopes management

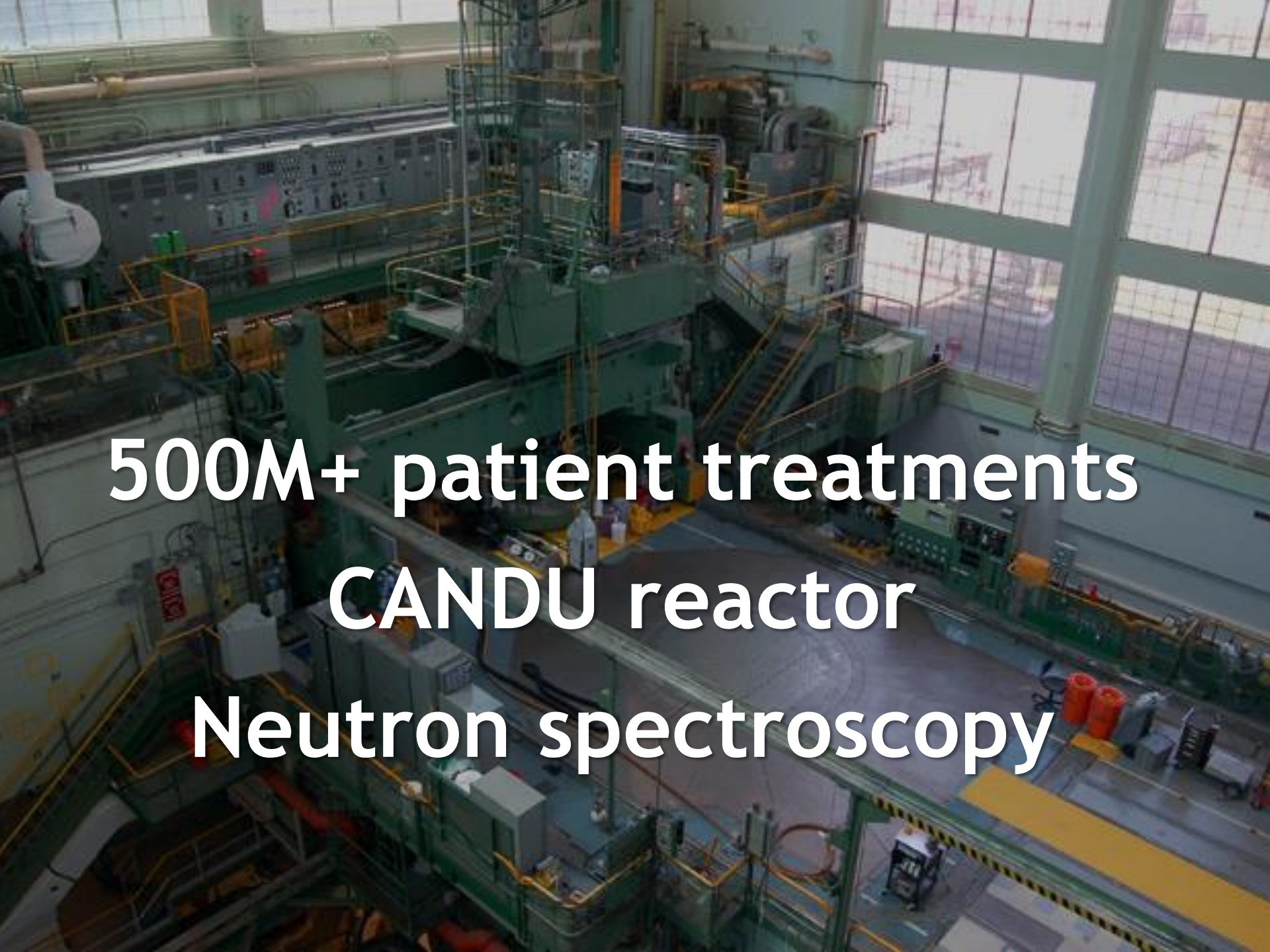
Nuclear safety, security and risk management

Nuclear and systems engineering

Nuclear chemistry applications

Canadian Nuclear Laboratories | Laboratoires Nucléaires Canadiens


The NRU reactor
enabled 60 years of
scientific innovation.


500M+ patient treatments
CANDU reactor
Neutron spectroscopy


so now what?

Context shaping our strategy

- Canada is committed to achieving its climate goals
- Nuclear power is **18% of Canada's energy mix**
- Nuclear science and technology (S&T) drives a **$6B** domestic industry and 60,000 jobs
- **$25B** is being invested to refurbish CANDU reactors
- Canada has established **federal nuclear S&T priorities** for CNL for 10 years
- Canada is **investing $1.2B** over 10 years in CNL to sustain the capabilities needed in its national nuclear laboratory
- **CNL's long-term strategy*** features small modular reactors, supporting existing reactor fleets and much more

*http://www.cnl.ca/site/media/Parent/Long_Term_Strategy_2017April18.pdf

Canada's Nuclear S&T Priorities

Science & Technology
Federal

Supporting the development of **biological applications** and understanding the **implications of radiation on living things**

Enhancing **national and global security** by supporting **non-proliferation and counter-terrorism**

Nuclear preparedness and emergency response

Supporting **safe, secure and responsible use** and development of **nuclear technologies**

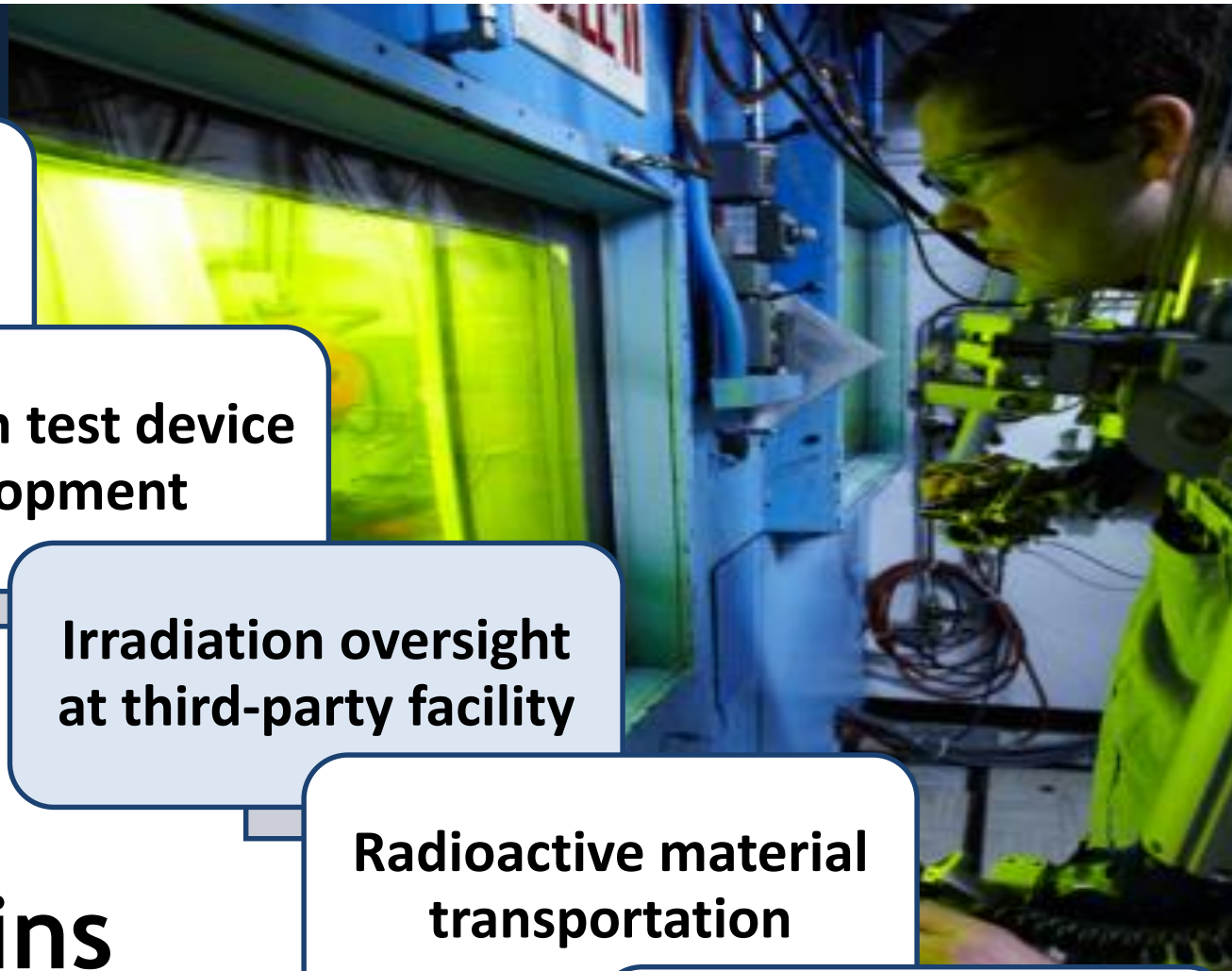
Supporting **environmental stewardship** and radioactive **waste management**

ENERGY

HEALTH

SAFETY & SECURITY

ENVIRONMENT



Experimental program design

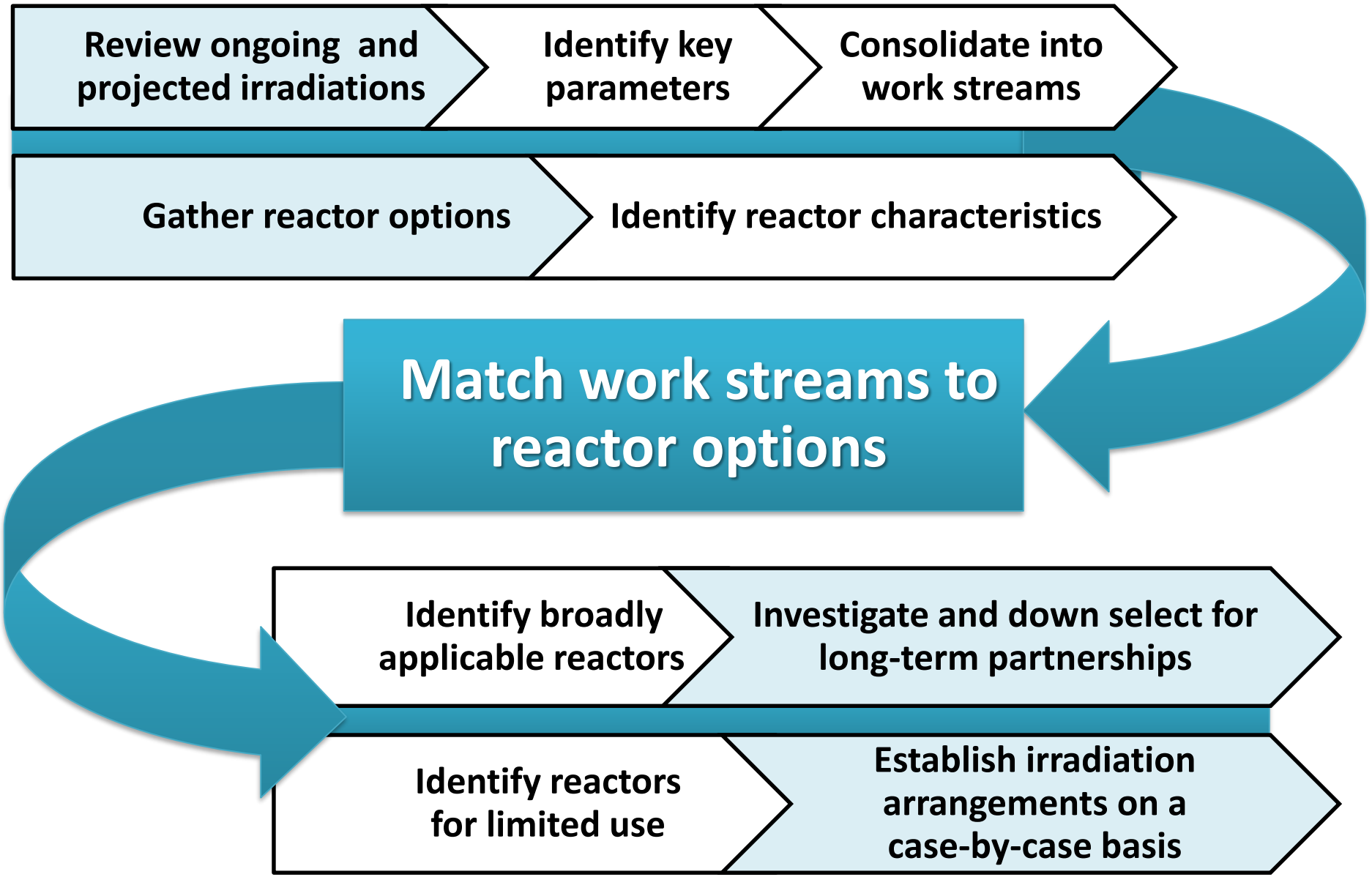
Irradiation test device development

Irradiation oversight at third-party facility

Radioactive material transportation

Post-irradiation examination and analysis

CNL remains a one-stop-shop for nuclear R&D.


Review ongoing and projected irradiations
Identify key parameters
Consolidate into work streams
Gather reactor options
Identify reactor characteristics
Match work streams to reactor options
Identify broadly applicable reactors
Investigate and down select for long-term partnerships
Identify reactors for limited use
Establish irradiation arrangements on a case-by-case basis

Projecting irradiation demand

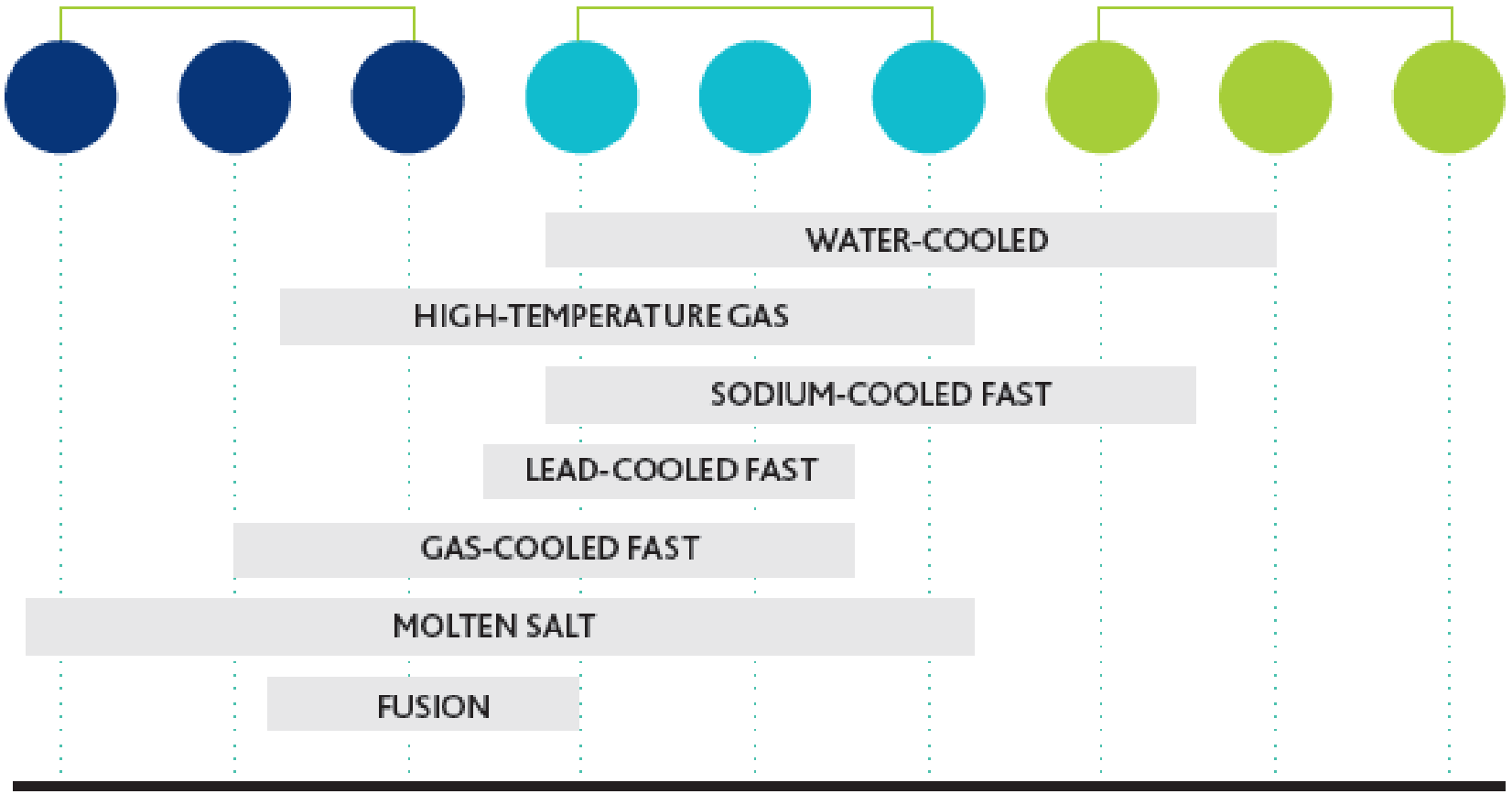
- Support the development of various reactor designs through fuels and materials irradiations, including specific **small modular reactor** fuels for qualification, and **next generation fuel** development
- Underpin studies and experiments related to the aging, safety and life-extension of **CANDU and light-water reactors**
- Support the **training and skills development** of Canada's future nuclear workforce
- Preserve and advance strategically important CNL facilities and expertise
- Leverage existing irradiated material inventory and nuclear data while addressing knowledge gaps related to the development of fuels of interest to Canada and commercial fuel vendors

Advancing SMR Technology Readiness

TRL 1-3
Fundamental principle and proof-of-concept testing

TRL 4-6
Component or subsystem validation in lab or simulated environment

TRL 7-9
Prototype or operational deployment



http://www.cnl.ca/site/media/Parent/CNL_SmModularReactor_Report.pdf

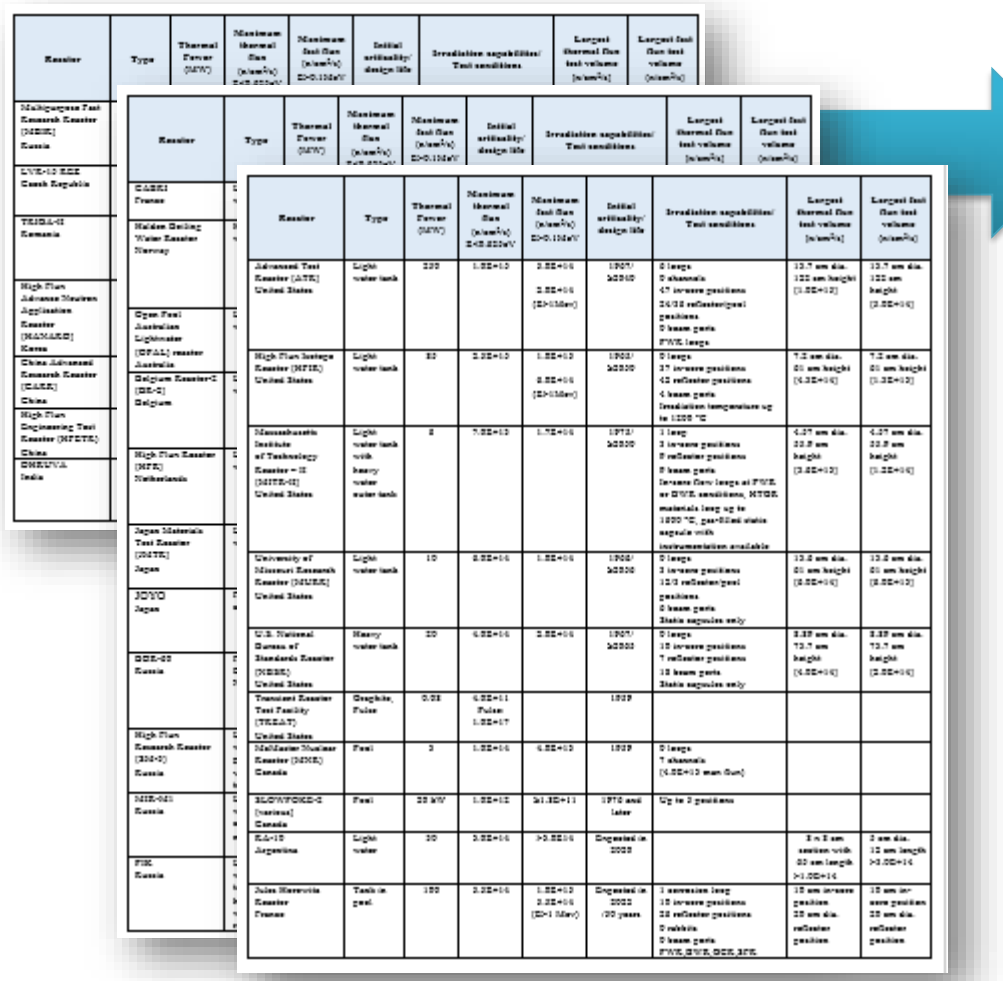
Defining key parameters for ongoing and future experimental programs

- Suggested/actual reactor used
- Required Power
- Required Max Thermal Flux
- Required Max Fast Flux
- Irradiation arrangement and test conditions
  - loop, in-core position/channel, reflector position, rabbit, beam port
  - gas-cooled, flows, pressure/temp, instrumented,…
- Required largest thermal flux test volume and thermal flux
- Required largest fast flux test volume and fast flux
- Time frame (dates), duration and number of tests
- Irradiation demand trend, drivers, etc.

Irradiation needs are varied.

Work Stream	Thermal Neutron Flux Required ($n/cm^2/s$)	Fast Neutron Flux Required ($n/cm^2/s$)	Irradiation Environment Conditions Required
FUEL			
CANDU Reactor	1.5 to 3.0E+14	>1.0E+14	Pressurized Heavy Water Reactor preferred (CANDU or Advanced CANDU Reactor)
Light Water Reactor	>1.0E+14	>1.0E+14	Light Water Reactor preferred
Research Reactor	>1.0E+14	>1.0E+14	Pool Reactor
Advanced Reactor (fast or thermal)	>2.0E+14	>2.0E+14 (up to 7E+15)	Design-specific advanced reactor conditions
Advanced Reactor (SCWR)	To be determined	>2.6E+13	Reactor-specific design conditions
MATERIAL			
High Neutron Damage	>1.5E+14	>1.0E+14	Reactor-specific design conditions
Corrosion Loops	0.4 to 1.5E+14	~5.0E+13	Reactor-specific design conditions

Identifying preliminary list of technical characteristics of existing research reactors



Evaluation Criteria

- ✓ Technical requirements
- ✓ Strategic partners and cooperation
- ✓ Cost, transportation, logistics
- ✓ Reactor accessibility and long-term availability
- ✓ CNL's ability to perform key activities to sustain technical competencies

Exploring several options to address technical requirements

- Utilizing multiple research reactors
- Setting up long-term agreements for reserved space with one or more reactors
- Leveraging the IAEA International Centre based on Research Reactors (ICERR) scheme
- Securing space in an operating power reactor
- Acquiring time on a new test reactor
- Participating in the development of a new test reactor

There is no one-size-fits-all solution.

Providing solutions to challenges in energy, health, safety, security and the environment

Science & Technology
Federal

Science & Technology
Commercial

Decommissioning &
Waste Management

ENERGY

HEALTH

SAFETY & SECURITY

ENVIRONMENT

What amazing things is the world turning to Chalk River for?

Clean energy. Health care.
Industrial solutions. Advanced fuels.
Innovative technology.

For starters.

Thank you
Merci

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