



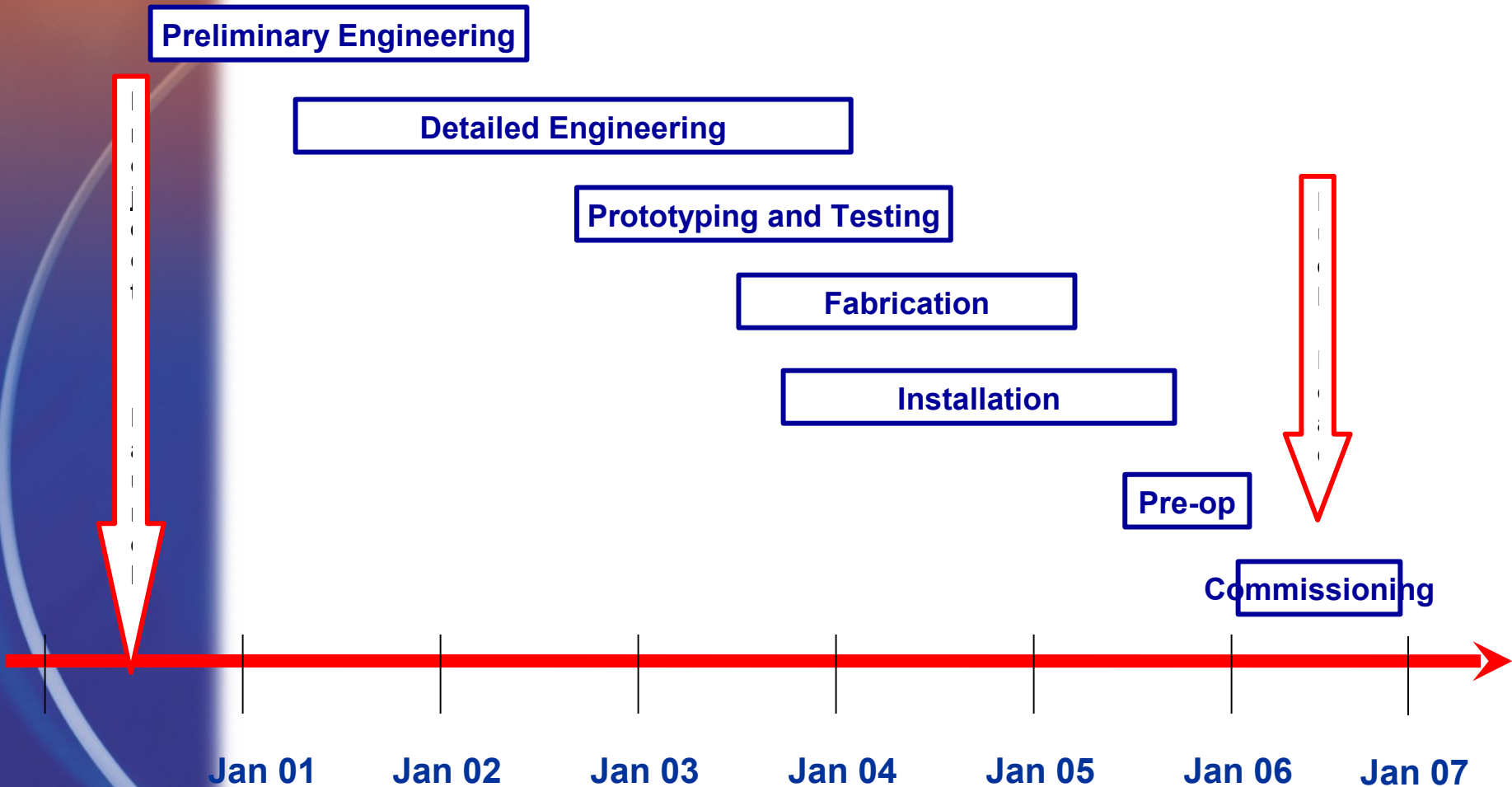
Australian Government

Australian Nuclear Science & Technology Organisation

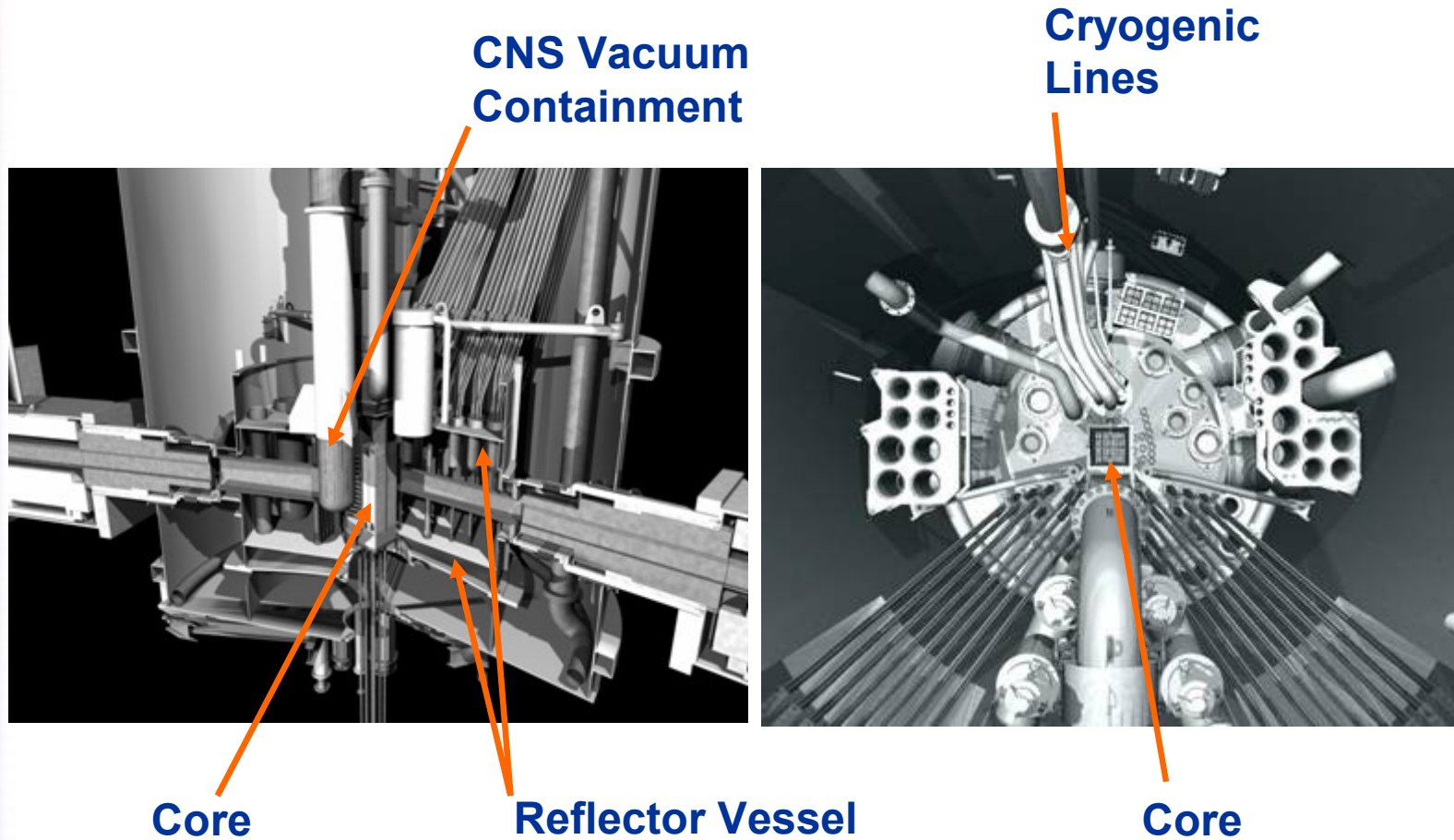
OPAL : Cold Neutron Source Commissioning Progress Update



CNS Progress to Date



OPAL Reactor Facility



The CNS Systems

1. In-pile Components (also combining a reflector plug)

Vacuum containment: Zircalloy (ZrNb2.5%)

Moderator chamber: Aluminium (AlMg5)

Sub-contracted: PNPI

2. Cryogenic Refrigeration System

He circuit, Brayton cycle, 19.8K at 5000W

Sub-contracted: Air Liquide

3. Moderator System

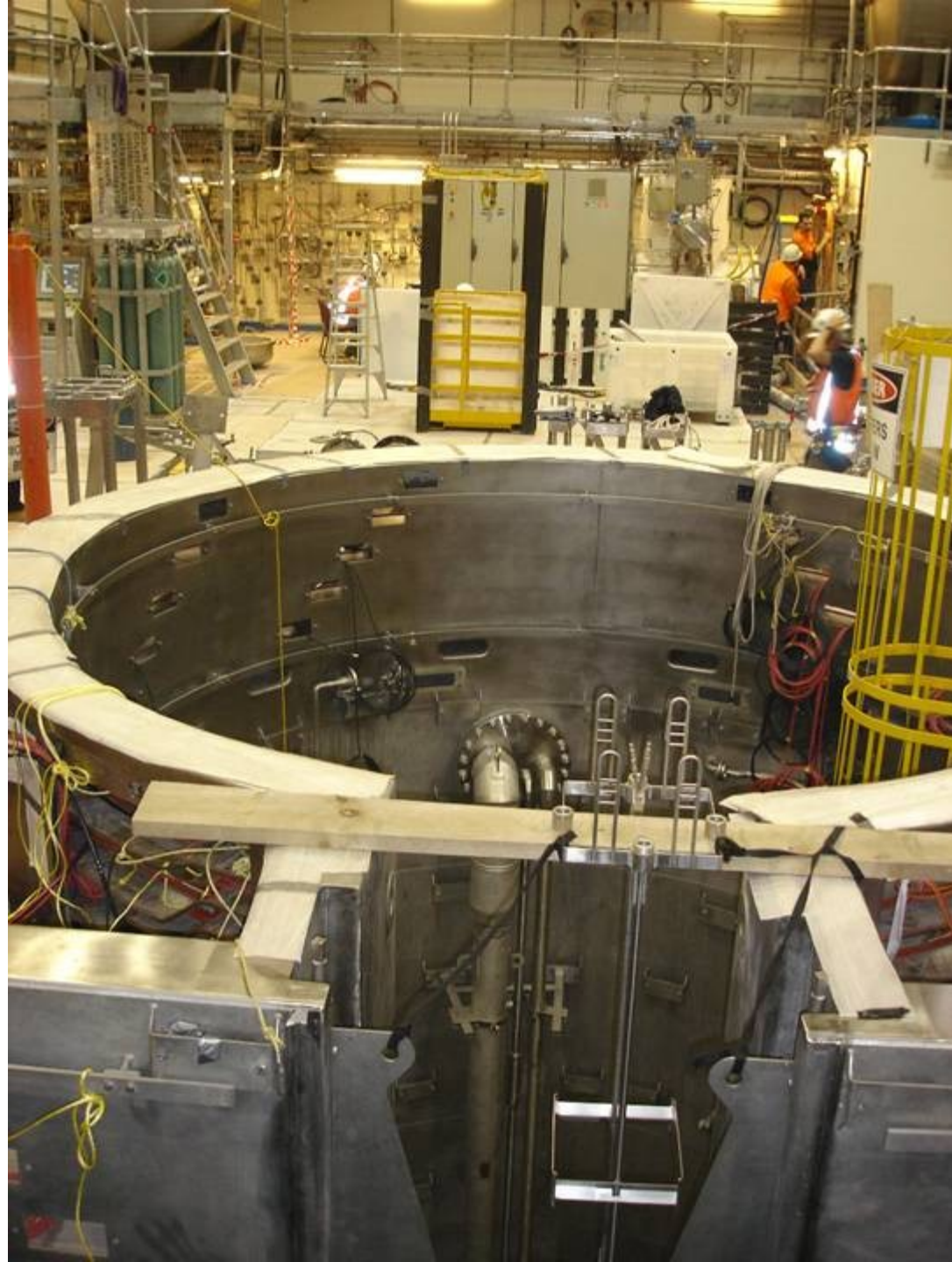
Liquid deuterium, ~ 24K

4. Vacuum System

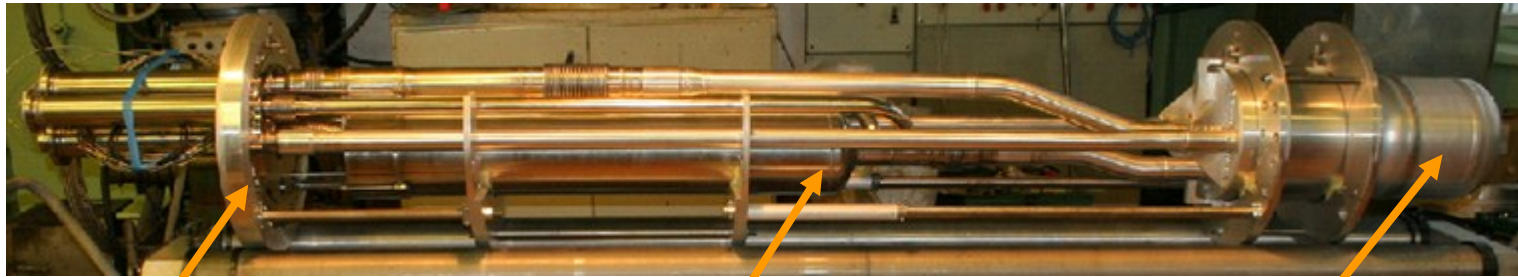
5. Gas Blanketing System

INVAP

Ansto



CNS In-pile

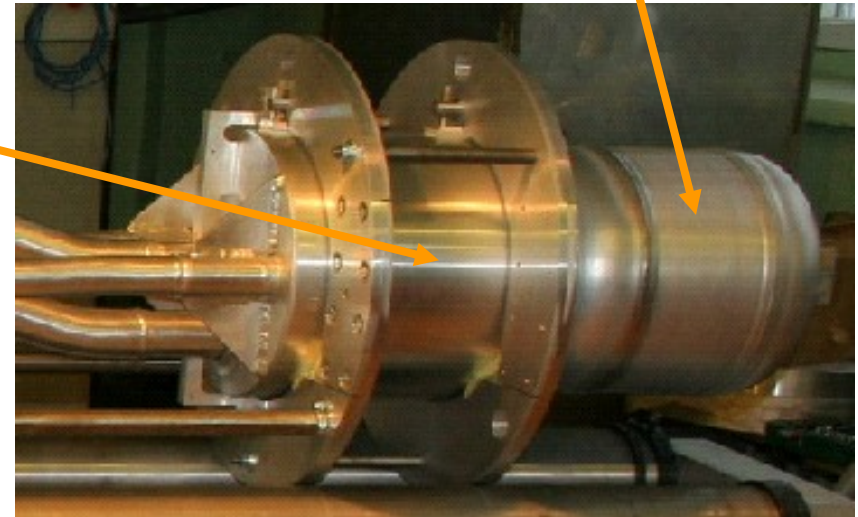


Flange

Heat Exchanger

Moderator Chamber

Heavy water plug (shielding)



CNS In-pile

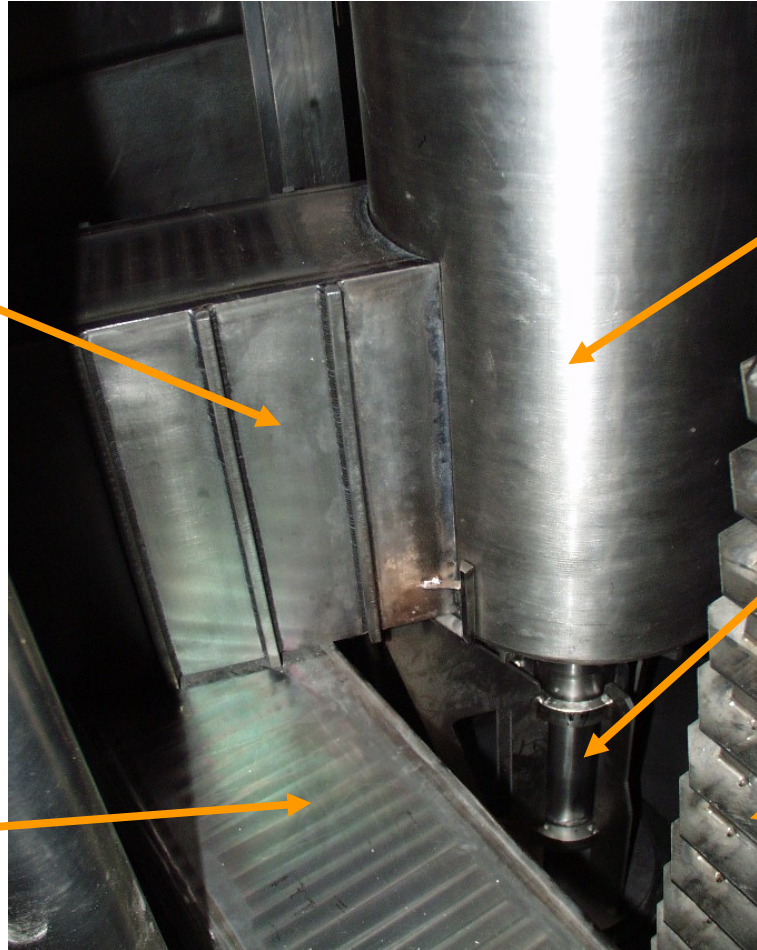
**CNS Beam
tube**

**HNS Beam
tube**

**Vacuum
containment**

**Alignment
pin**

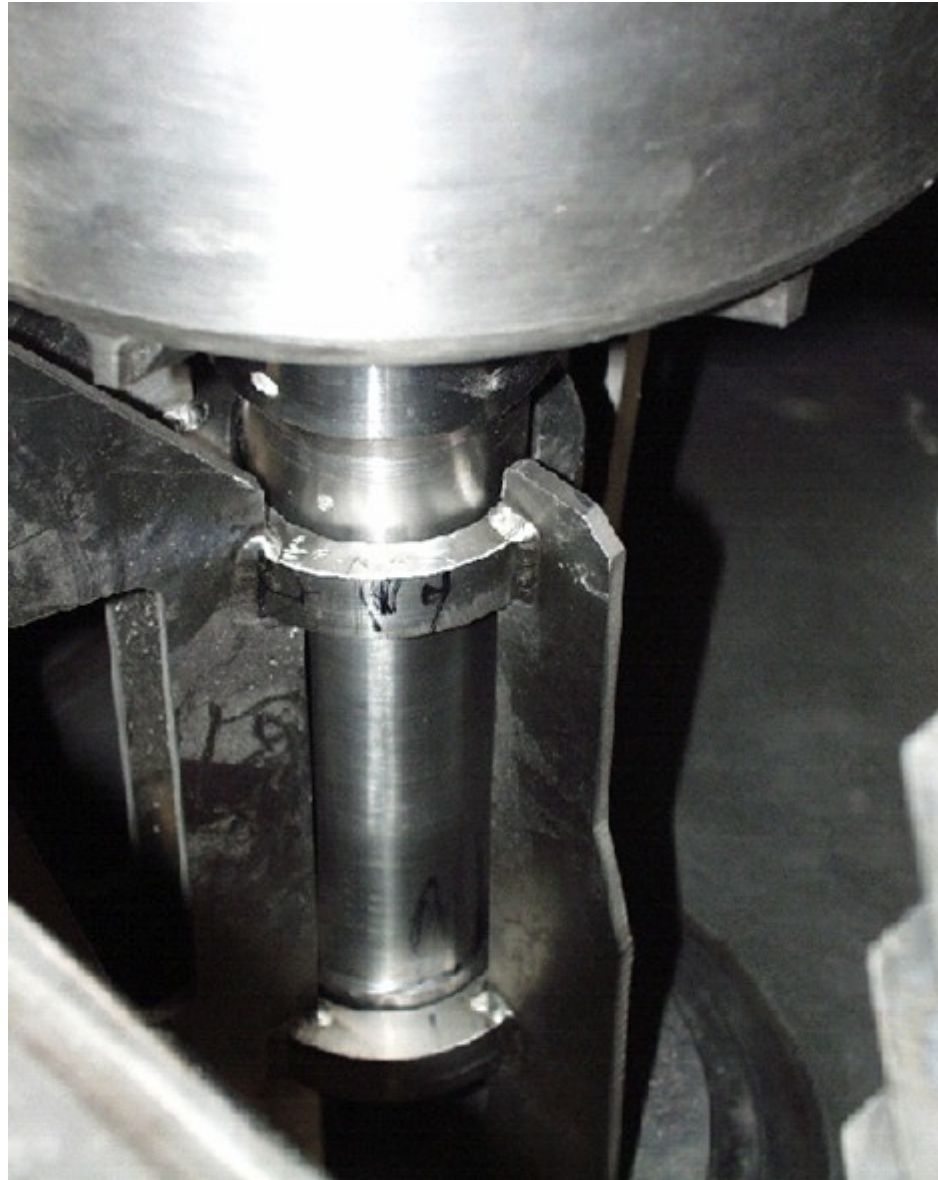
Core



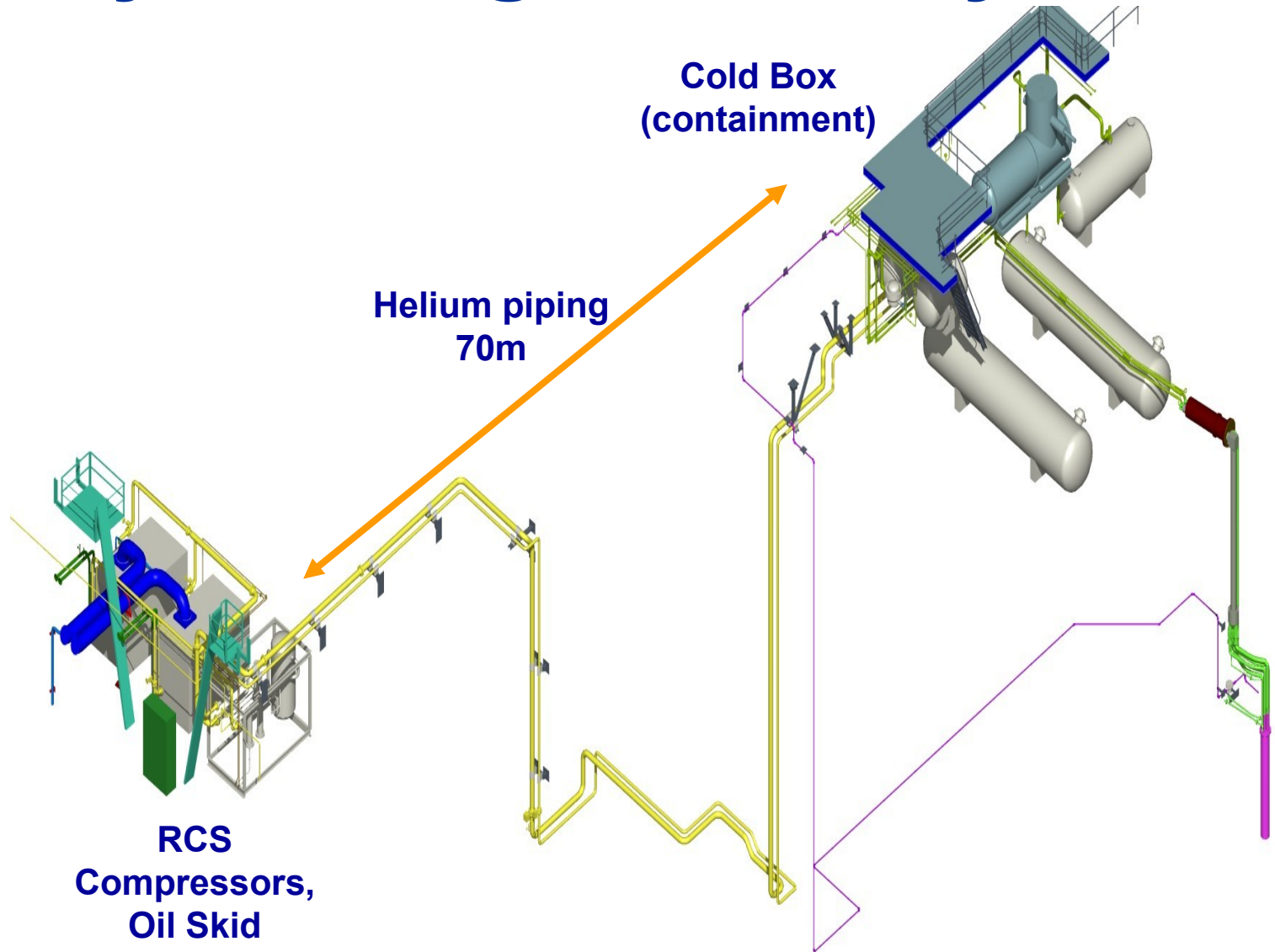
INVAP

Ansto

CNS In-pile



Cryo Refrigeration System



Cryo Refrigeration System



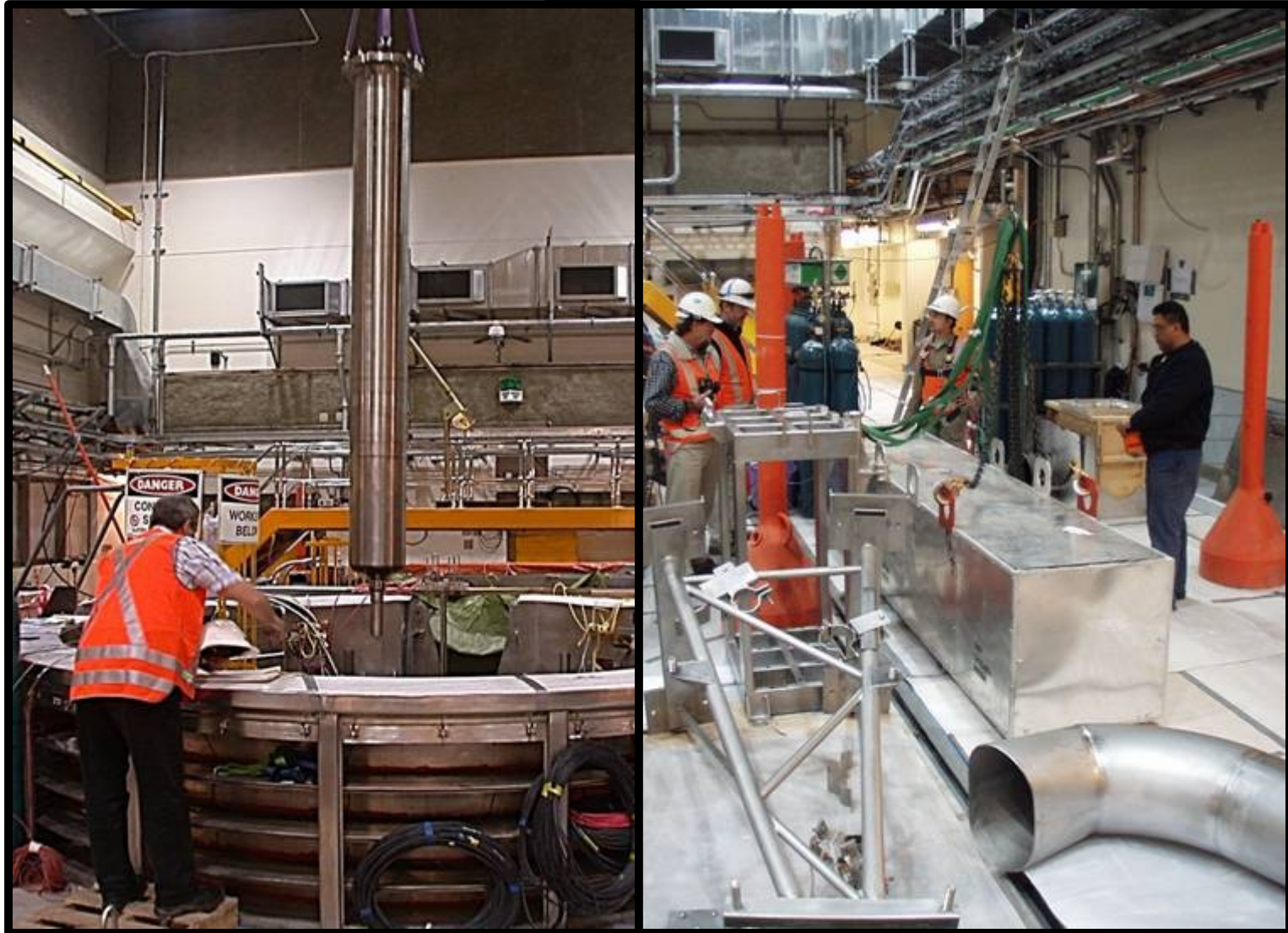
Cryo Refrigeration System



Vacuum & Moderator Systems



Installation



Installation

Compressors, oil skid, cold box delivered – Mar 05

Compressors, oil skid, cold box installed – June 05

Moderator system installed – June 2005

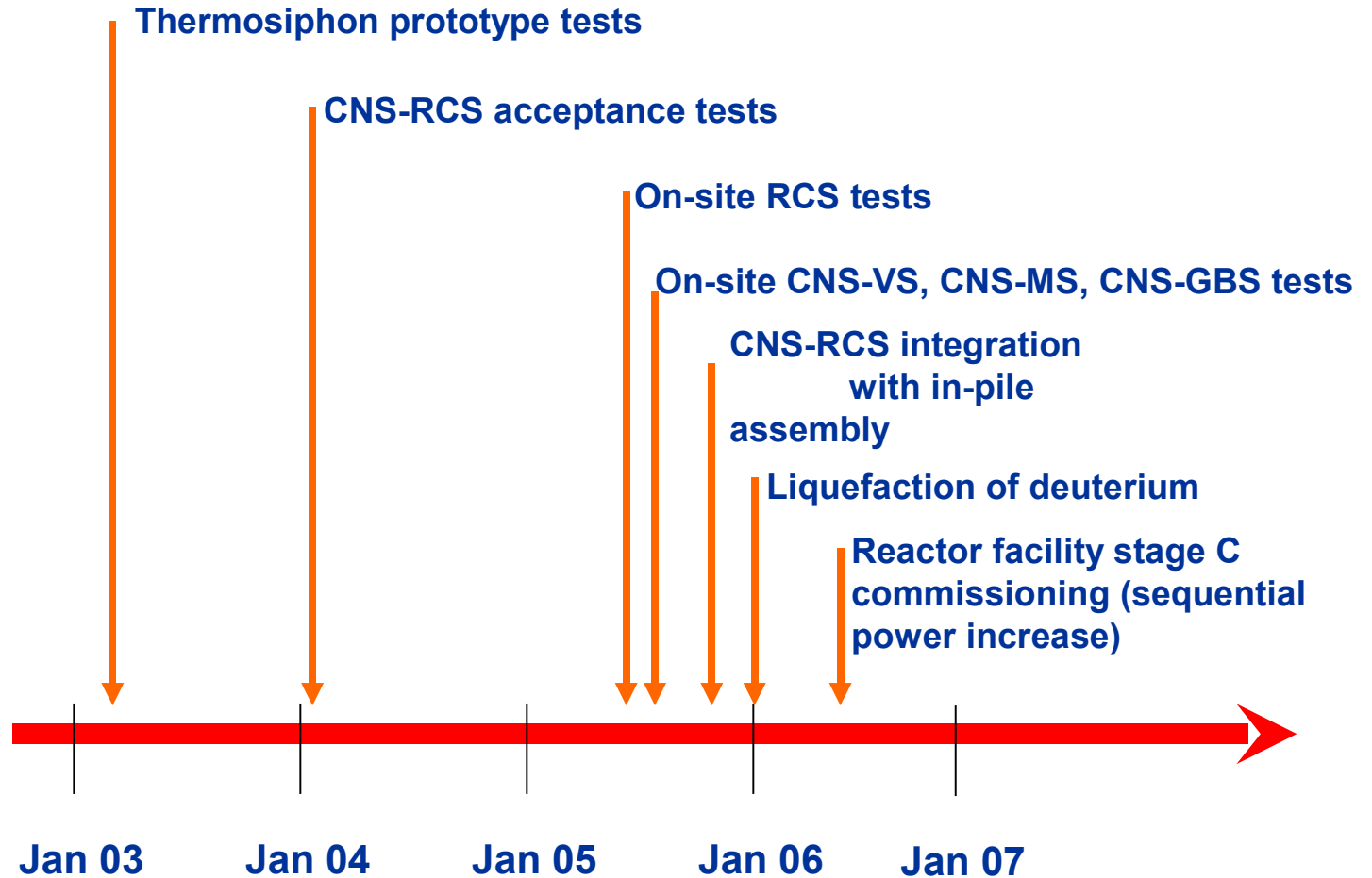
Vacuum system installed – June 2005

Vacuum containment fitted to reflector – Aug 2005

Cryo pipe installed - Aug 2005

In-pile assembly installation – Sept 2005

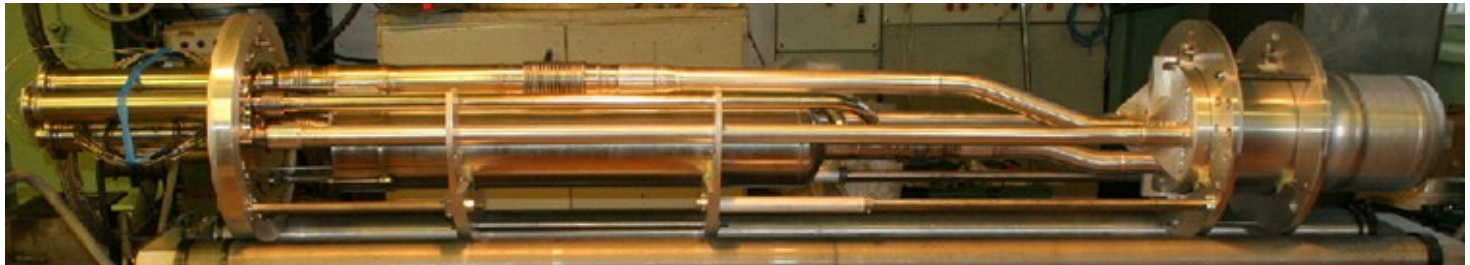
CNS Testing Schedule



In-pile Prototype Testing (PNPI)

AIM: To prove heat removal by thermosiphon

PROTOTYPE: Moderator chamber and thermosiphon. Two electric heaters modelled nuclear heating.



RESULTS:

Operation in normal cryogenic mode with 4300 W heat input.

Operation in warm stand-by mode with 2650 W heat input.

RCS Factory Acceptance Test (Air Liquid)



RCS Testing (Air Liquid)

TEST PROGRAM

CONCLUSIONS

- 5.6 kW heat removal capacity (during Normal Operation).
- Stand-by operation, and transition between modes successful.

LESSONS LEARNT

- Bypass loop, on the cryogenic helium lines
- Helium relief tank
- Clean helium system

On-Site CNS-RCS Testing

July 05

Cold box bypass fitted

Tuning of control loops to guarantee:

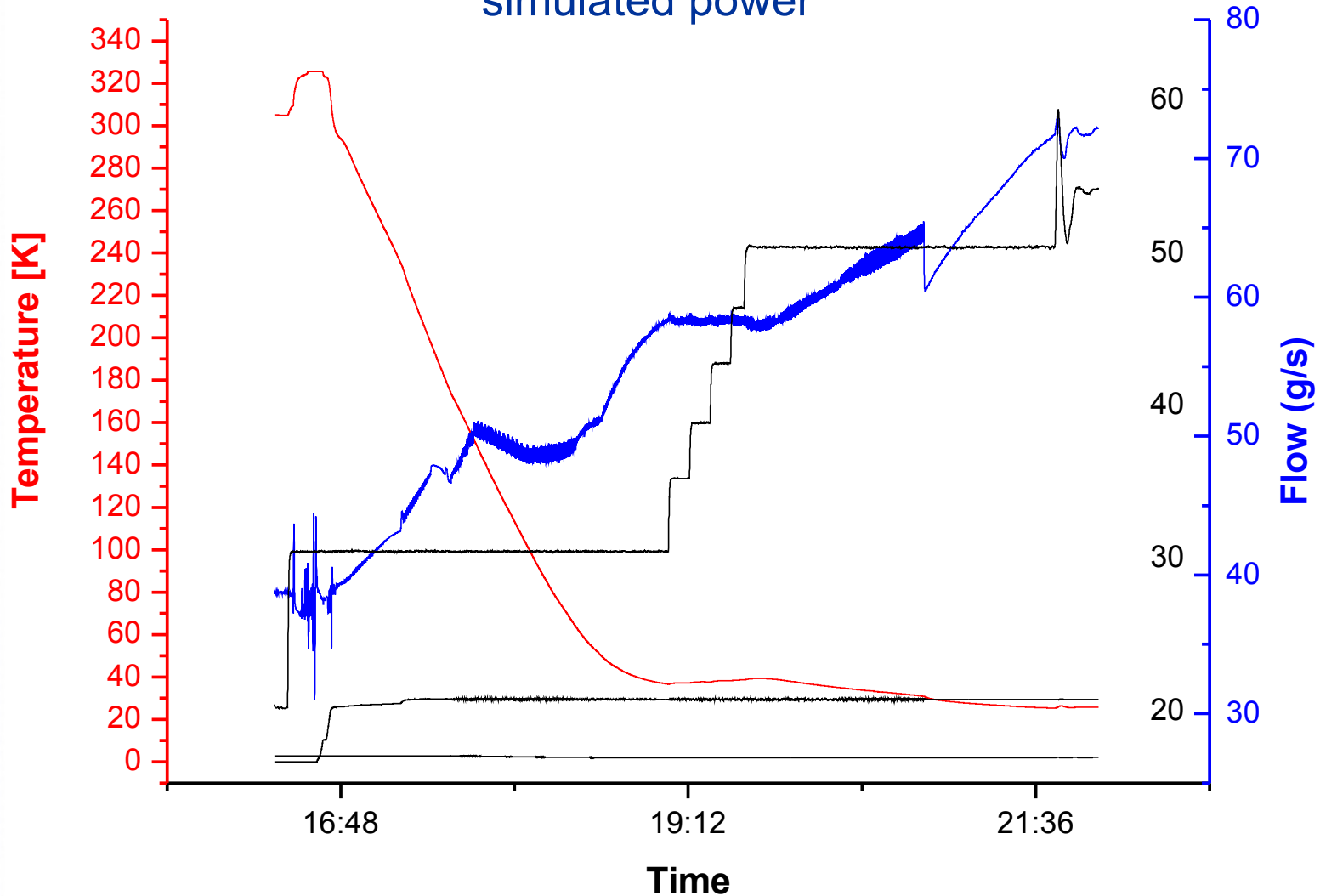
- **required flow to the moderator cell**
- **prevent moderator chamber over-pressurisation**

Loss of one compressor – no reactor trip

Containment isolation – no He relief

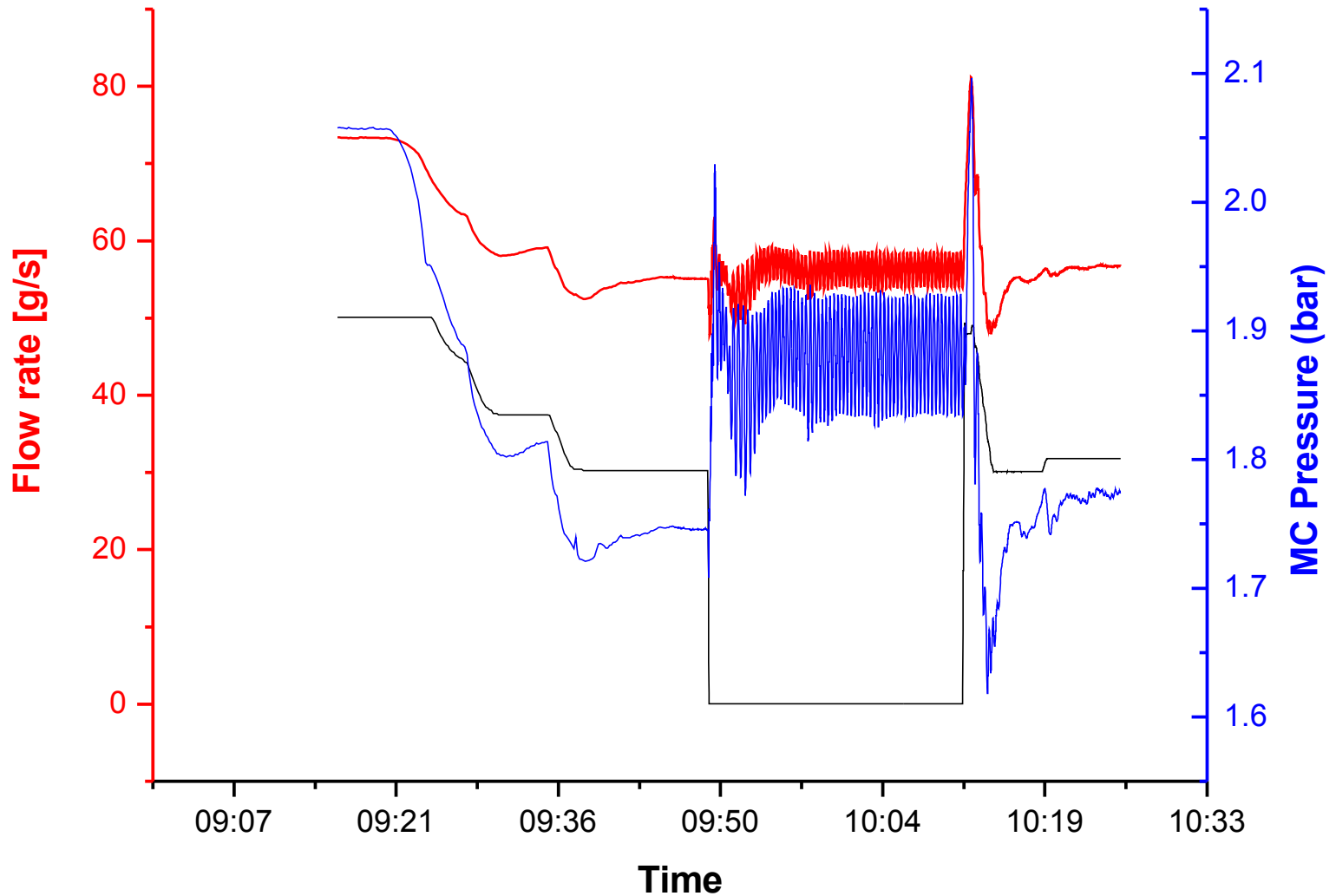
On-Site Testing

Transition from SO (warm) mode to NO (cryogenic) mode with simulated power



On-Site Testing

CNS trip due to failure of compressor A



On-Site CNS-RCS Testing



Operation

Normal Operating Mode (**NO**)

Stand-by Operating Mode (**SO**)

Halt Mode

Fast Warm-up – rapid deuterium vapour warm-up

Forced Evaporation – accelerated return to reactor power

Helium injection into the vacuum containment