Australian Government

Australian Nuclear Science and Technology Organisation

The OPAL Reactor

Australian Government

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Project Achievements

- Performance:
  - Thermal flux to beams exceeds expectations (preliminary result)
- Schedule:
  - 9 years from government approval to first full power
- Budget:
  - Cost is 8% above original budget (adjusted for inflation and foreign exchange fluctuations)

Stakeholders

- Established strong, broad stakeholder support at the outset
- Committed effort to maintain that support throughout the project
- Effective results and ongoing support

Assignment of Responsibility

- Single turnkey contract
- Detailed performance specification
- Contractor given complete design responsibility
- ANSTO reviewed designs against the performance specification

Contractor Selection

- 2 stage tender process – Prequalification and then Main tender round
- Main tender round – need to demonstrate that performance could be achieved
- Prequalification – need to demonstrate chance of success in Main round

ANSTO's Role Post-Contract

- Reviewed designs prior to manufacture
- Witnessed selected inspections and tests
- Reviewed procurement, manufacturing and installation documentation
- Interface with the regulator
- Reporting to stakeholders
- Participated in commissioning

ANSTO / INVAP Relationship

- ANSTO View:
  - Excellent ongoing working relationship with INVAP
  - INVAP work characterised by strong corporate and personal commitment to build a facility they would be proud of
  - Effective communications protocol

Project Management Tools

- Work Breakdown Structure
- Project Schedule
- Quality Assurance
- Risk Assessment
- Communications
- Project Control
- Licensing

Work Breakdown Structure

- WBS: 350 Work Packages
- During project planning used for:
  - Assigning responsibilities, Cost estimating, Scheduling
- During project execution used for:
  - Progress assessment, Cost and schedule control

Project Schedule

- Project Master Schedule at WP level
- Specific schedules for specific activities
- Floating times managed at project level
- Weekly (at times, daily) survey of critical path activities
- Awareness by all the parties of how valuable is every project day

Quality Assurance

- ISO 9001: quality is responsibility of the execution level
- Experienced people
- Generous design margins and extensive prototyping and testing
- Document control (more than 15,000 documents)
- Quality Controls and Audits (more than 1,000 SITPs)

Risk Assessment

- Formal procedures for project risk assessment
- Risk register from tender
- Risks classified in accordance to probability and consequences in five categories
- Contingency plans for major risks
- Status of top ten risks surveyed every month & risk register every six months

Communications

- Preliminary and Critical Design Reviews
- Weekly project status meeting
- Monthly Contract Status Report
- Quarterly Project Review Meetings
- Weekly meetings with Regulatory Body
- Daily meetings during commissioning
- More than four thousands letters

Project Control

- Most controls are at Work Package level
- Earned Value methodology
  - Time is money: Schedule Variance
  - Cost Variance
- Cost to finish every three months
- Zero-base estimate every year

Licensing

- One-of-a-kind facility
- Regulatory approval of detail engineering
- Single point of contact between the regulatory body and the project
- Frequent, periodic meetings between the three parties are essential
- Top management involvement in licensing is mandatory.

Hot Commissioning

- ARPANSA issued the Operating Licence in July 2006 allowing fuel to be loaded
- All testing was carried out to written procedures
- For each test, INVAP nominated a Test Responsible and ANSTO nominated a test Lead
- Reactor Operations by accredited ANSTO operators under INVAP supervision

OPAL Control Room

Stage B1

- Start up core with three different uranium loadings.
- First critical 12 August 2006 with 14 fuel assemblies loaded
- First Shutdown System shutdown value

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Stage B2

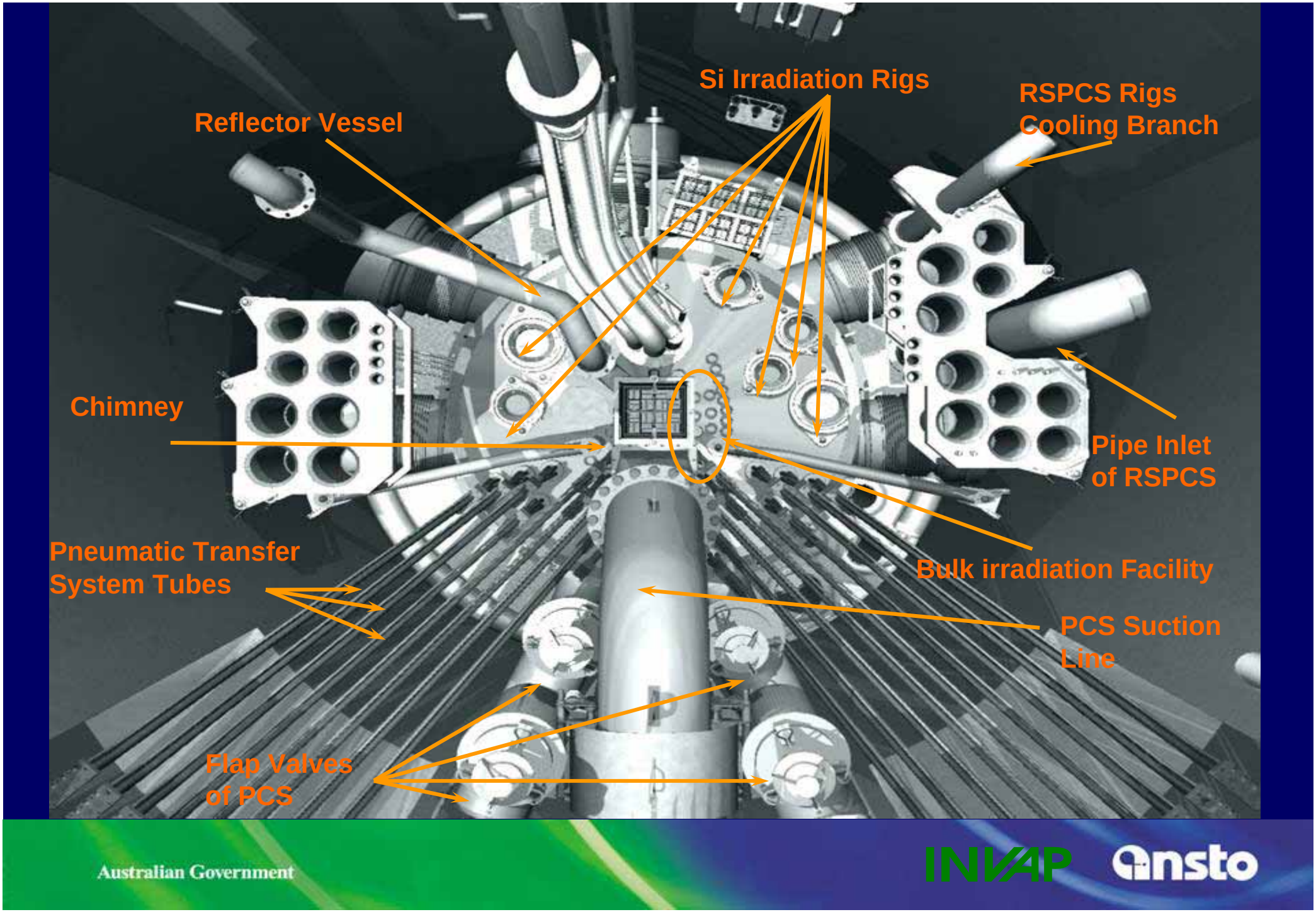
- 22 main tests at powers up to 400kW
- Completed loading of full core 16 fuel assemblies
- Irradiation of gold wires for determination of power peaking factor, reactivity worth of facilities and calibration of nuclear instrumentation
- All feedback coefficients confirmed negative

Stage C

- Reactor power increased in steps to 20 MW
- Nucleonic instrumentation calibration at 3 MW from thermal balance
- Loss of normal electrical supply test from full load
- 20 MW achieved 3 November 2006

Commissioning Issues

- Noise in nucleonics instrumentation
- Wide range nucleonics detectors change from pulse to Campbell mode
- CNS turbine
- Core outlet temperature sensors
- Cooling tower performance
- Delay in completion of irradiation facilities


Si Irradiation Rigs
Reflector Vessel
RSPCS Rigs
Cooling Branch
Chimney
Pipe Inlet
of RSPCS
Pneumatic Transfer
System Tubes
Bulk irradiation Facility
PCS Suction
Line
Flap Valves
of PCS

Reactor Schedule

- First refuelling completed February
- PPF measurement by gold wires
- Complete Stage C commissioning
- Commission CNS
- Commission neutron beam instruments
- Reflector vessel
- Complete commissioning of irradiation facilities

Project Results

- OPAL has been a successful project for all parties involved
- OPAL is operating normally
- Performance tests to date show the required fluxes have been or will be achieved or exceeded