NINTH SECOND HARMONIC RF/LOW OUTPUT-IMPEDANCE AMPLIFIER COLLABORATION MEETING

ARGONNE NATIONAL LABORATORY

JUNE 14 –15, 2004

WA Morris

ISIS 2RF PROJECT STATUS REPORT

Introduction

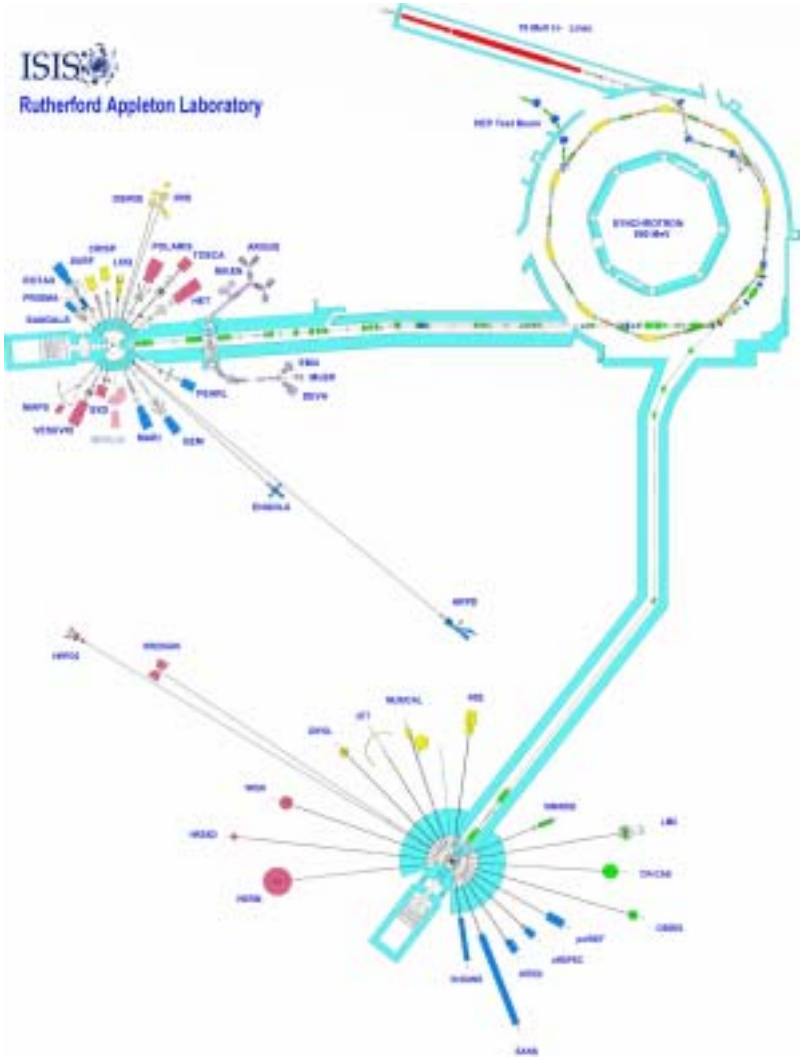
- The 2RF project is to design, manufacture install and commission four second harmonic cavities on ISIS,

- Theoretical modelling has indicated that the introduction of a second harmonic RF system will increase the beam intensity by 50% from 200µA to 300µA,

- The increased 300µAmps beam current will allow 240µAmps to be delivered to the existing target and by means of switching techniques be used to deliver 60µAmps to a second target station,

- To achieve the increased current, upgrades to the Linac and Target are necessary and will be completed in 2004.

ISIS



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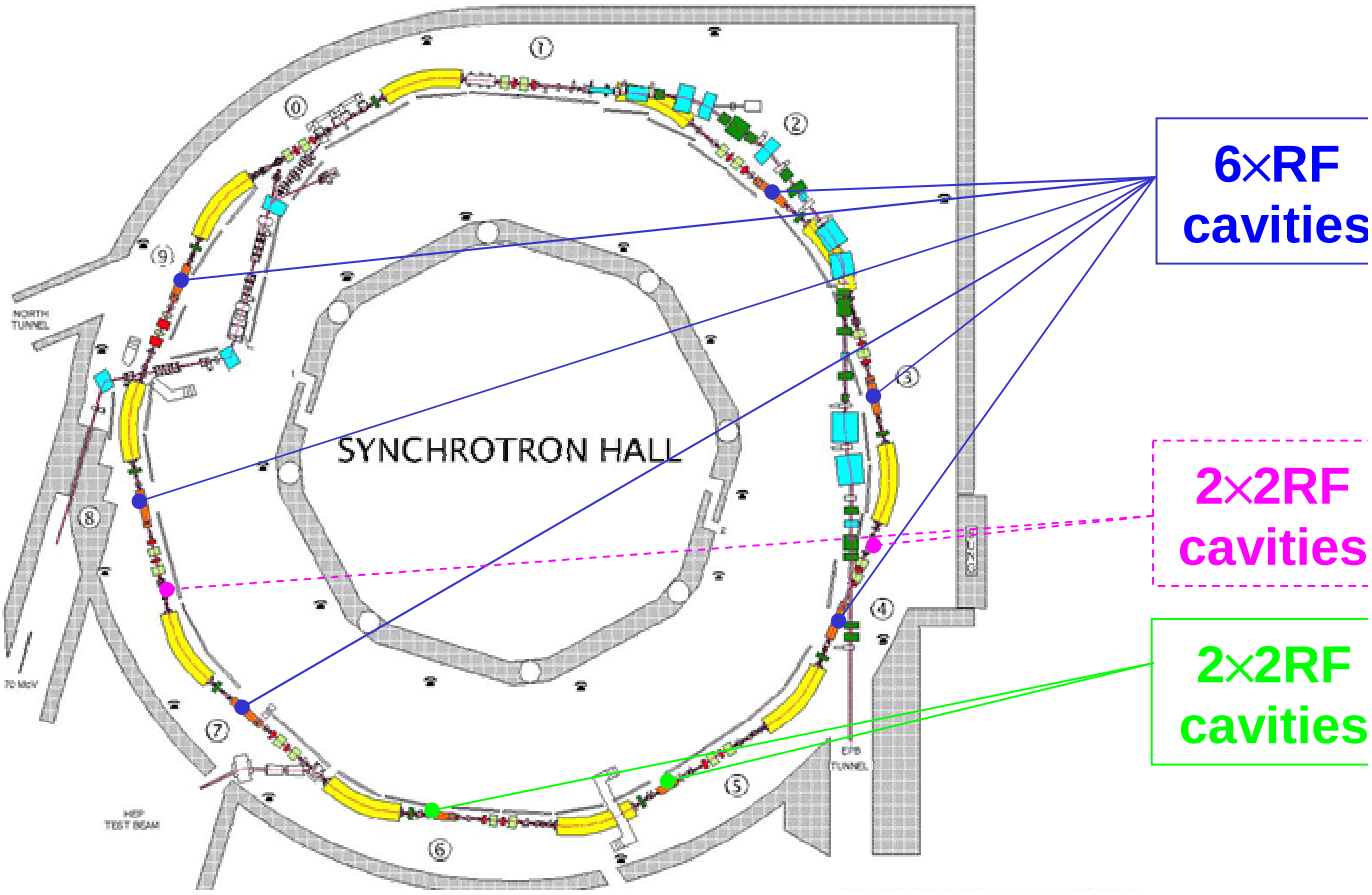
Synchrotron Layout



1 Low Power RF

LPRF rack layout adjacent to the main control room

All LPRF modules have been manufactured and installed in the diagnostic room ready for commissioning.
Modules for systems SP5 and SP6 were tested during the ISIS operation cycle in March 2004.
The remaining modules, for SP4 and SP8, will be commissioned for operation by the end of the Long Shut Down in 2004.

1.1 Low Power Driver

	Ops	Spares
Number required	4	2
Built	4	2
Installed	4	
Services completed	4	
Commissioned	2	

The Low Power Driver is a 500 W wide band commercial amplifier. Six have been purchased and tested.

2. High Power RF System

2.1 High Power Drives (HPD)

	Ops	Spares
Number required	4	1
Built	5	
Installed	4	
Services completed	2	
Commissioned	2	

Each cavity is supplied with RF power from a 250 kW tetrode amplifier. The amplifier requires a high voltage supply from the APS (up to 20kV) and is housed with all the necessary support equipment.

Terry Weston and John Berry building an HPD

3. Synchrotron RF Cavities

Number required	4
Built	5
Installed	4
Services completed	2
Commissioned	2

Ferrite and cooling pancakes have been manufactured for all cavities along with a supply of spares. These components are identical to those in the fundamental system. Four cavities are now installed in synchrotron superperiod 5 (SP5), 6 (SP6), 4 (SP4) and 8 SP8. The vacuum systems were completed to programme and the services are nearing completion.

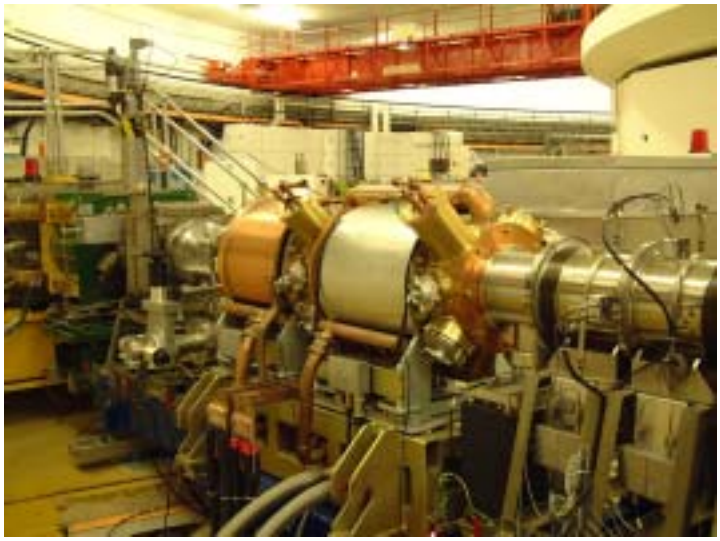
SP6 with components removed and new base supports being installed

SP6 cavity installed and vacuum restored.

HPD's and Cavity

- **HPD for 2RF system SP6 installed**

- **2RF cavity installed in SP5.**



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SP4

2RF cavity in SP4 location

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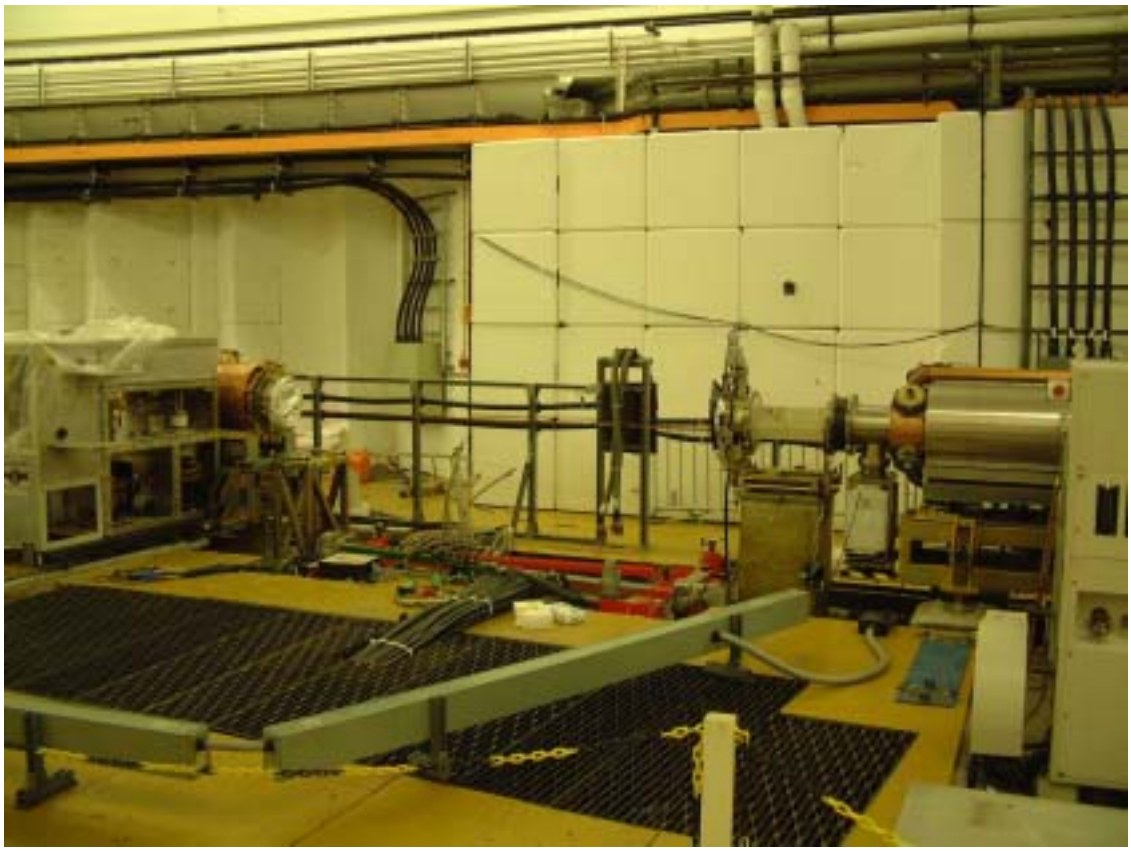
2RF cavity and HPD in SP4

SP8

Fundamental and 2RF Cavities in SP8



SP8 Fundamental and 2RF

4. High Power RF Supplies

4.1 Hall 2

Most of the power supply equipment is located in Hall 2 (R5.4). To enable the siting of the power equipment a mezzanine platform was built. The platform houses the four LVPS bias power supplies and 16 racks for screen and grid power supplies for the Tetrodes in the High Power Drive (HPD) units. 10 km of power cables, control and interlock cables have been installed.

Hall 2 platform with racks for the HPD power supplies and controls

4.2 Cavity Bias Regulator LVPS

	Ops	Spare
Number required	4	1
Built	4	1
Installed	4	
Services completed	4	
Commissioned	2	

Hall 2 platform showing the four LVPS for the Bias systems.

4.3 Cavity Bias Regulators and Cables

	Ops	Spares
Number required	4	1
Built	5	1
Installed	4	
Services completed	3	
Commissioned	0	

The series regulators control the current to the variable bias field by altering the ferrite μ value. Four regulators are now in place and support services are being installed. Currents as low as a few amps and as high as several thousand amps will flow in this circuit. 4-core aluminium cables run from the Bias Systems to the cavities. The four cores are configured to keep the cable inductance value low.

The Cavity Bias regulators

Bias Regulators

View of the four Bias Transistor Regulators

The sixteen, 4-core aluminium cables that run from the Bias Regulators to the cavities.

4.4 Anode Power Supplies

	Ops	Spares
Number required	4	1
Built	5	
Installed	3	
Services completed	3	
Commissioned	2	

Five 20kV, 10Amp power supplies have been delivered and three are installed in Hall 2 with the forth about to be installed.

Two of the high voltage anode power supplies in Hall 2.

5. Power Transformers and Electrical Distribution

Number required	4
Built	4
Installed	4
Services completed	4
Commissioned	4

New power transformers (11kV/415V) and a 415V distribution switchboard were installed to meet the power demand for the fundamental RF and 2nd harmonic RF load. Work started in early January 02 and was completed during April 02.

The new outdoor transformer bay showing two of the four 1.5MVA transformers

New power cables have been installed to supply fundamental RF and 2nd harmonic RF equipment from the 415V switchboard. The power system is now energised and is supplying the fundamental RF systems.

New 415V distribution board in Hall 2 (R5.4)

6. Civil Engineering

The civil engineering has been completed for superperiods 4 and 8 cavities.
Further mechanical work is in progress to close the ring and vac down.

The electrical installations and water systems are being installed and this work is scheduled to be completed by July 17th when commissioning will start.

7. Target Station and LINAC RFQ

The new target station reflector is complete and being installed during the 2004 shutdown. Installation is scheduled to start Aug 11th and be completed by Aug 18th

The RFQ is installed and work is in progress to connect all services.
Commissioning is scheduled to start July 3rd and completion by Aug 9th

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Conclusion

- The project required scheduling as an integral part of the operation programme, not an easy task considering the necessary forced adjustments that an operations schedule requires.

- The project is now in its final stages and scheduled to be commissioned by the USER run which starts 13 Oct 04.

- To-date two cavities are commissioned and RF injected into the synchrotron.

- Current Spend is approx £5.6M with £0.4M still to cover the work for completion.

- The original project costing was carried out in the mid 1990's by Robin Bendall and Mike Glover with a review by Adrian Morris and Ian Gardner when funding was applied for. Robin and Mike's estimates were excellent and the project is expected to be about £50k over the £6M budget.

- Many thanks to all the staff involved in this project, too many to mention individually, but without each one's contribution would not be the success that it is so far.