

# 6<sup>th</sup> Design and Engineering of Neutron Instruments Meeting

Organized by ANSTO in Sydney (Australia)

28 November – 1 December 2017

Co-editors' names for these proceedings (ISNIE executive board members):

- David C. Anderson (ORNL/SNS, Oak Ridge, TN, USA)
- Sylvain Désert (LLB, Gif sur Yvette, France)
- Nancy Hadad (NCNR, Gaithersburg, MD, USA)
- Iain Sutton (ESS, Lund, Sweden)

Local organizers of the meeting:

- Scott R. Olsen (also ISNIE executive board member)
- Andrew Eltobaji
- Frank Darmann
- Stewart A. Pullen
- Kirrily C. Rule

The Design and Engineering of Neutron Instruments Meeting series began at the Rutherford Appleton Labs, Oxford (UK) in 2012. This annual series brings together a wide range of technical staff, principally engineers, responsible for designing and operating neutron scattering facilities. Since then, this yearly event has been held in ORNL (Oak-Ridge TN, USA) in 2013, FRM II (Munich, Germany) in 2014, BNC (Budapest, Hungary) in 2015, ESS (Lund, Sweden) in 2016 and recently was held at ANSTO, Sydney (Australia).

In total 85 people attended the conference with 10 companies sponsoring this event (Fig. 1). The 85 people from 16 countries participated with the largest contingent (outside of Australia) from the ESS and JCNS. The conference was underpinned by three plenary talks which all related to the theme of neutron instrument design history and lessons to take forward into the future. The first plenary, held as the opening talk of the conference, was presented by Dr Margaret Elcombe of ANSTO, titled “How 50 years with HIFAR shaped the Australian Centre for Neutron Scattering”. The second plenary presented by Prof. Ken Andersen of the ESS discussed “The next 50 years of Neutron Scattering – a brave attempt at extrapolating current trends way beyond their reasonable validity”. On the final day Mr Iain Sutton, also of the ESS, gave a talk titled “Event Horizon, an exploration of the future of neutron scattering facilities”. In this talk, many great blue-sky ideas were presented, including one to build an international neutron scattering facility on the moon, as many shielding problems will be eliminated due to the reduced number of humans there!

The program consisted of 3 breakout sessions, 22 topic talks and 29 posters presented across 4 days. The breakout sessions focused on 1) Instrument Build, Commissioning and Operation 2) Automation, Measurement and Monitoring and 3) Beam Conditioning, Metrology and Shielding. All conference delegates were welcome to participate in their preferred session.

From the Instrument Build, Commissioning and Operation breakout session the key themes that emerged were:

- Know what you want upfront, and have a tight team of like-minded and focused people with this mutual goal.

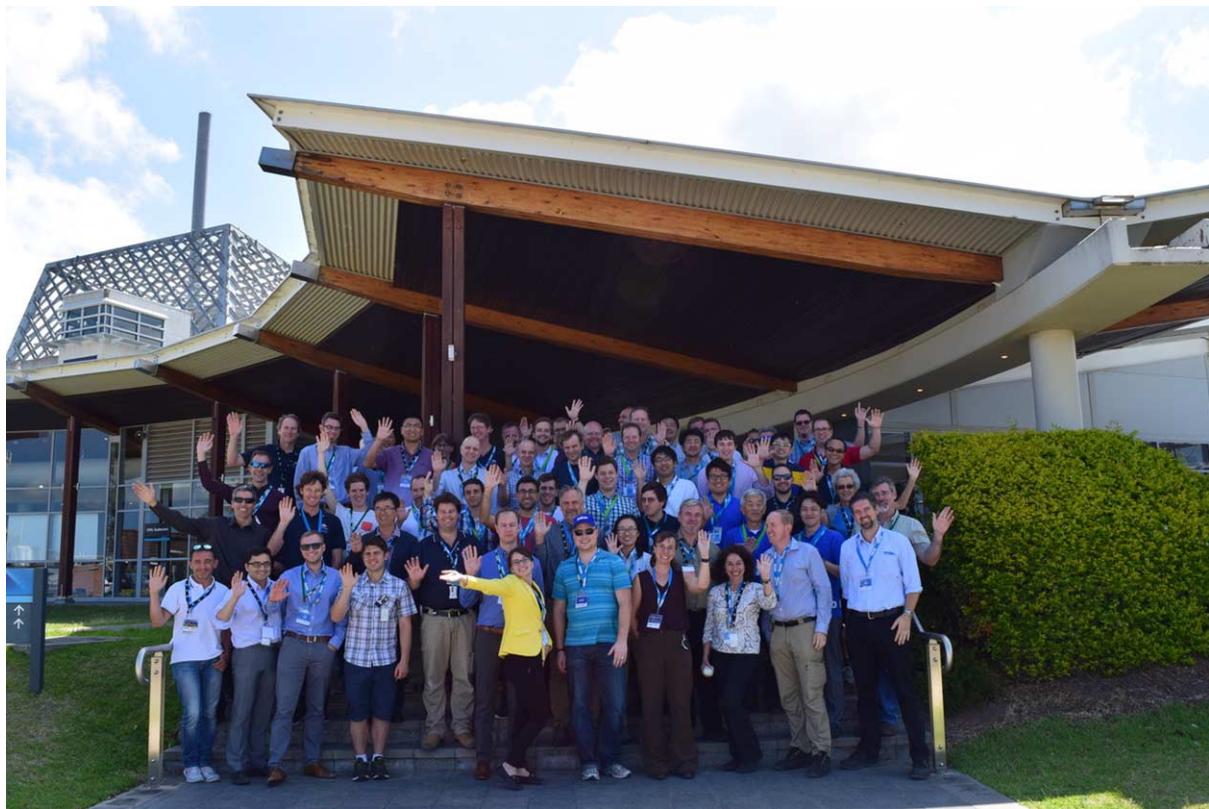


Fig. 1. DENIM 2017 participants in front of the OPAL Reactor.

- Where costs or specifications are not well known, obtain some scoping funds first.
- Engage key vendors early, communicate frequently and ask for budget estimates. Explain your funding process and timing requirements.
- For the Project Manager – Conduct design reviews and have a good governance structure.
- If key resources are scarce try to get external personnel for non-critical tasks.

From the Automation, Measurement and Monitoring breakout session the key themes were:

- At large facilities with many new instruments coming online it is hard to get teams to complete jobs (as-built schematics, etc.) to a sufficiently high standard.
- Silo effects between groups coupled with poor communication between team members can lead to barriers which can prevent effective collaboration.
- Overlapping skill sets between groups (IT/mechanical/electrical/scientific etc) is beneficial.
- Brainstorming techniques & corridor conversations are effective ways to work on problems.
- Lots of pairs of eyes peering through a variety of lenses are required in design reviews to increase accountability and reliability.
- Schematics must reflect as-built/as-installed.
- Design from the beginning, an expansion plan for the life of the Instrument / Facility.
- Motion control electronics location: there is a trade-off between central (easier to maintain) and decentralisation (cheaper to cable).
- Integration takes a lot of time, however this will pay off during long-term operations.

From the Beam Conditioning, Metrology and Shielding breakout session the key themes were:



Fig. 2. Winners of the DENIM challenge which took place late on day 1 to promote team building across different facilities and disciplines. Sponsors were included. The challenge of this event was to build the Sydney Harbour Bridge using only paper, sticky tape and to decorate it. A great way to break the ice.

- Immunity from radiation damage is critical for sensors on choppers, slits etc as the flux of sources increases. Vendors are looking into this.
- Vendor relationships are important and for remote facilities the ability for the vendor to remotely login to monitor their equipment is extremely handy.
- To optimise shielding for detectors use a Bonner sphere or similar device to try to isolate the source, energy and direction of the neutrons.
- PSI are looking into very high density ( $\rho = 5$ ) concrete with 5% B<sub>4</sub>C included in the mix.
- A number of facilities have now included small removable sections of shielding to allow access for metrology equipment to the guides to check for guide alignment.
- Most facilities are now regularly performing gold foil checks to confirm flux and alignment.
- The limited number of guide vendors could lead to bottlenecks for facility upgrades.
- 3D printing of shielding materials, including borated materials is progressing well.

The 22 topic talks were broken into 7 Sections 1) Project Management 2) Operations and Maintenance 3) Guides and Shielding 4) Choppers and Sources 5) Instrument and Motion Control 6) Detector Systems and 7) Beam Shaping, Slits and Conditioning Methods. All talks were presented in an open manner with the mistakes-made and solutions-found presented such that audience members could learn from the experiences of the speakers.

DENIM VI was held outside of Europe and the US for the first time. One of the advantages in the ANSTO bid was that we would be more accessible to new facilities from the Asia-Oceania region. This was largely achieved with a number of delegates representing J-PARC, JRR-3M and RIKEN in Japan, CSNS and the IHEP in China, KAERI in Korea, CNEA in Argentina from NECSA in South Africa. Aside from J-PARC, we believe the other facilities listed had not previously attended before. Conversely the representation from European facilities was down from DENIMs IV and V which were both held in Europe. Representation from North America remained constant.

A major achievement at DENIM VI was the formation of the ISNIE, the International Society of Neutron Instrument Engineers – the aim of the society is to foster greater collaboration amongst the entire community for the purpose of neutron instrumentation.

Key themes that came out of the conference were 1) Increasing Automation and Remote Handling 2) Additive Manufacturing and 3-D printing of shielding materials 3) Next generation Neutron Detectors (e.g.  $^{10}\text{B}$ ) and 4) Chopper & Shielding designs for the next generation of instruments.

There was a site tour of ANSTO, including the Neutron Guide Hall, neutron cold source replacement project mock up facility and the new instruments at the Centre for Accelerator Science. To foster lively discussions, participants were invited to participate in a challenge consisting in building the Sydney Harbour Bridge using only paper and sticky tape (Fig. 2). There was also a behind the scenes engineering tour of the iconic Sydney Opera House, which included discussions on how to keep this land mark infrastructure, now 45 years old running until 2060.