



CPD  online

# ANSTO's new SYMO plant uses Synroc Technology to Immobilize Nuclear Medicine Production Waste



# Pamela Naidoo- Ameglio,

---

Group Executive,  
Nuclear Precinct - ANSTO  
Executive Director-ANM



ENGINEERS  
AUSTRALIA

# Presentation Outline

---

- Introduction and Background
- Synroc development
- SyMo Design considerations
- SyMo Facility Construction and Equipment
- Operational Readiness
- Synroc in the Future

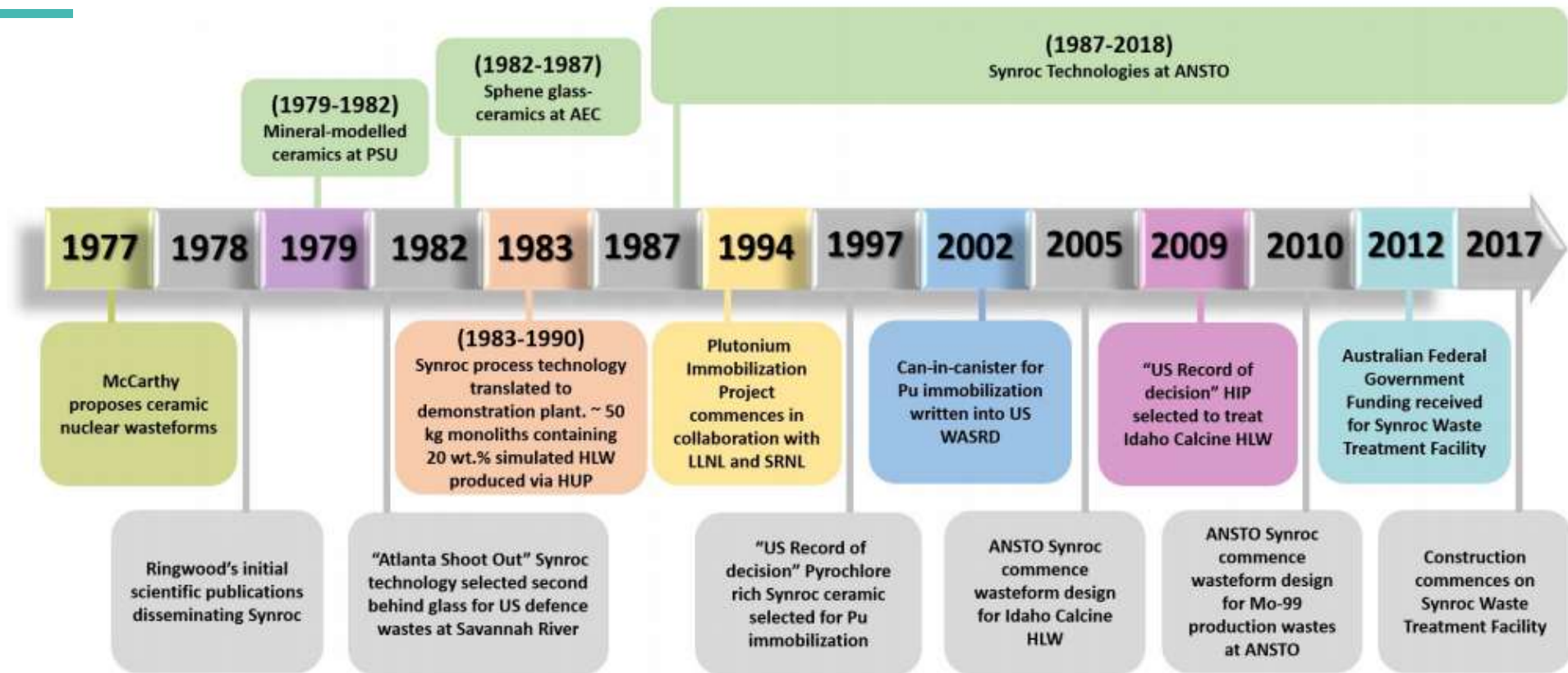
# Introduction and background

## Comparison of treated waste volume



# Synroc development

# Evolution of Synroc



Gregg et al, 2020. Synroc technology perspectives and current status. Journal of American Ceramic Society. Vol 103 -Issue 10

# ANM and Development of Synroc Project for Mo-99



ANM Building



SyMo

- Pre 2010 -laboratory and modest pilot scale testing of processes
- 2012 Australian Government funding
- Technical maturation
- Industrial scale facility - SyMO



# SyMo Objectives: A complete solution

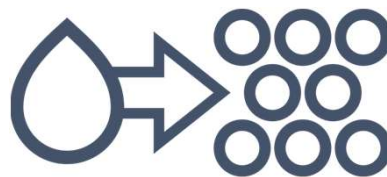
Mo-99 Nuclear  
Medicine  
Production Facility  
Liquid Waste

Produced from irradiated  
target plate dissolution



Mo-99 Waste  
Treatment Facility  
Process  
Technology

Transformation from  
liquid  
to solid waste



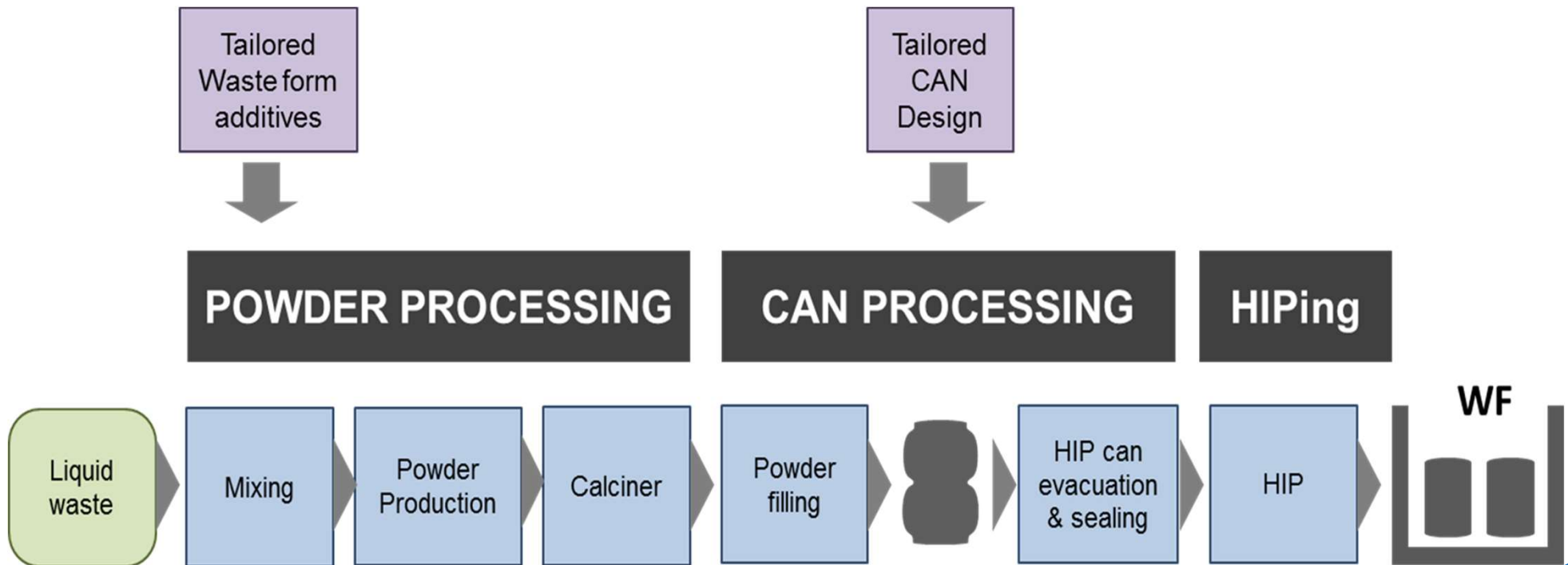
Storage  
Durable  
Wasteform

Product ready for  
long-term storage and  
final disposal

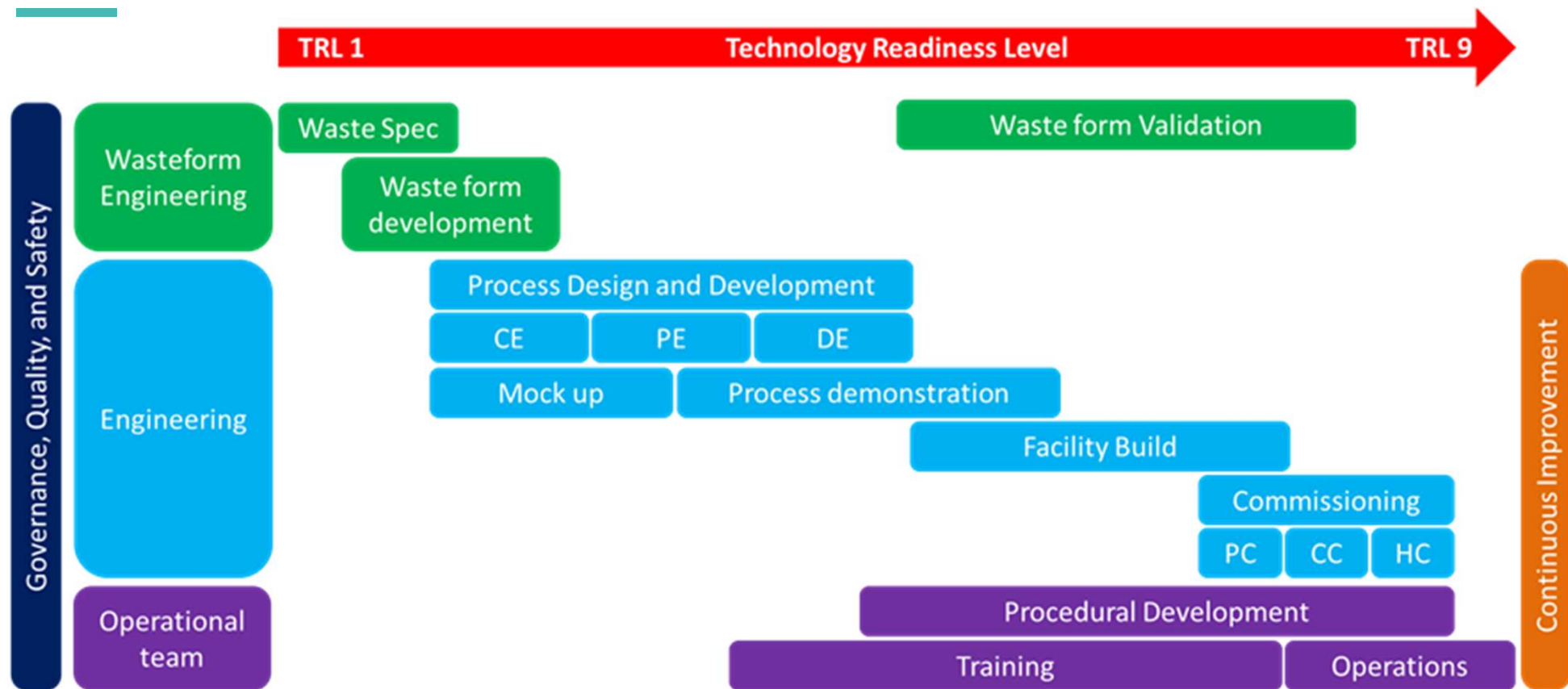


# SyMo Design Considerations

# How does SyMo process the ILW?



# Parallel design and construction project



# Plant Design – an iterative process

---

- Synroc process flow design and key components
- Inactive engineering demonstration facility
- Instrumentation and Control

# Synroc Inactive Engineering Demonstrator



- Surrogate chemistry (chemically identical, no radiation)
- Risk mitigation:
  - Process integration, Process boundaries
  - Training of engineers and operational engineering team
  - Test commissioning strategies



# Demonstration of HIP Process Technology



## Design features

- Performance spec for automatic pick/place system for HIP
- Nuclearisation of the HIP process
- Tailored can designed for wasteform and final repository requirement

# Can Processing – HIPing to scale



H = ~ 500 mm  
Pre-HIP Canister



# Operational Design considerations in Nuclear context

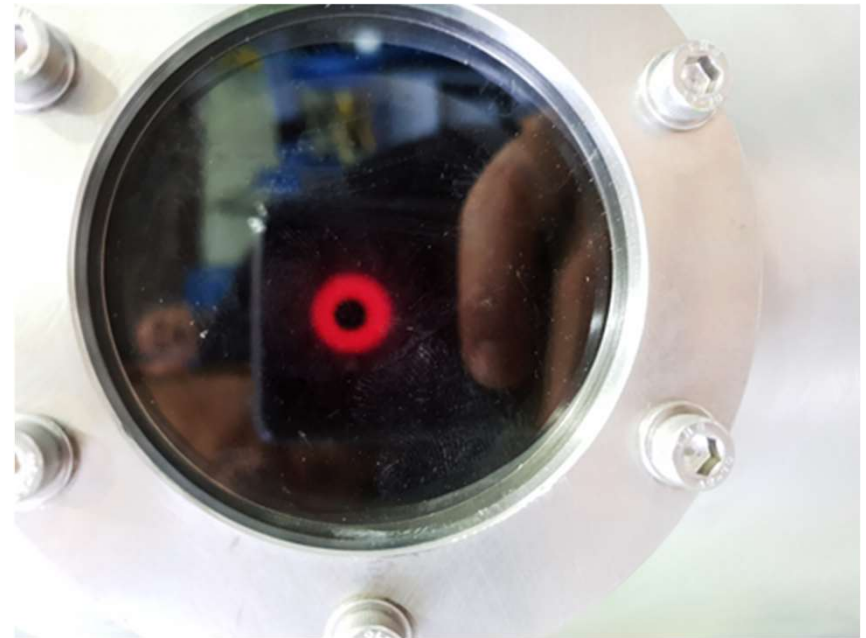
---

- Materials of construction
  - Change in type of cement for building
  - Equipment materials robustness
  - Shielding
- Process Optimisation
- Equipment maintenance
- Automation

# Process Technology Nuclearisation

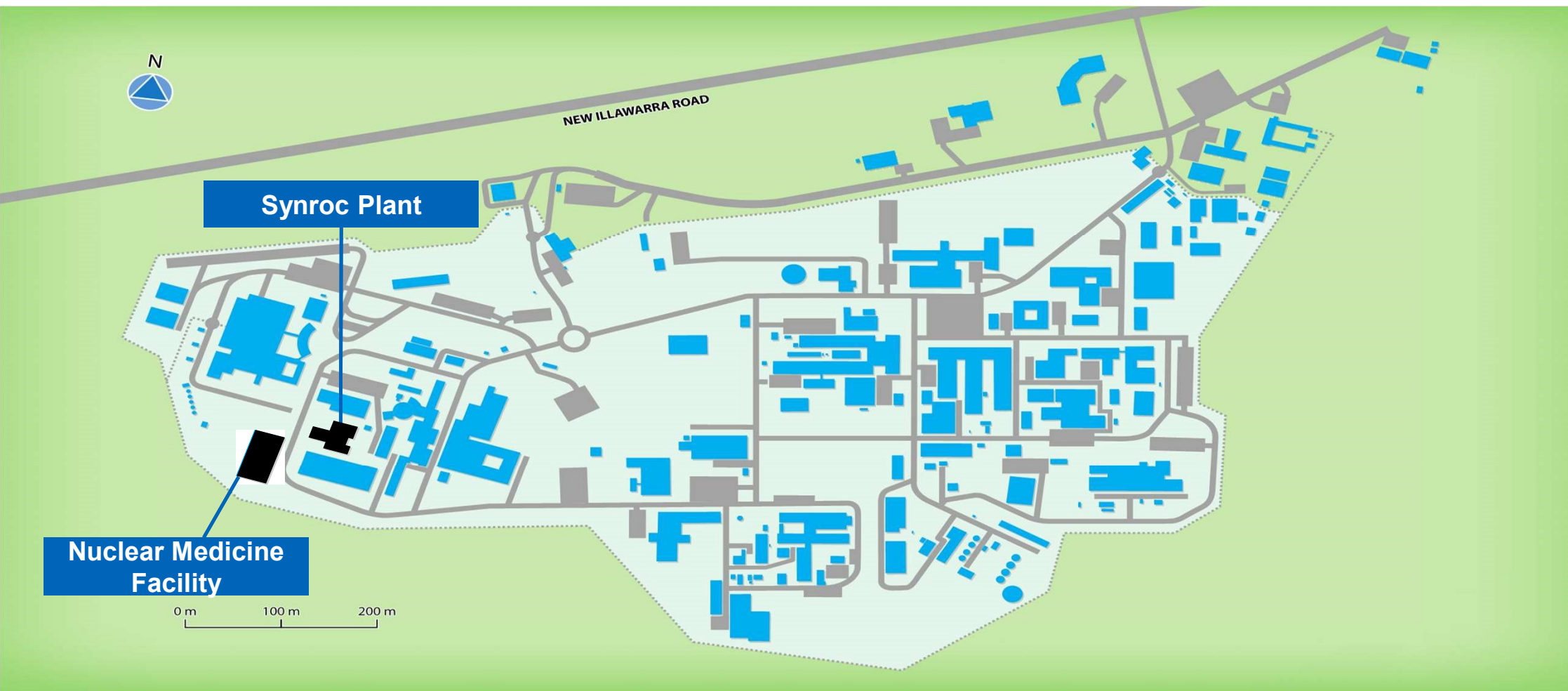


Rotary Calciner with highly modular designs



# SyMo Facility Construction and equipment

# Location and timelines of the SyMo plant

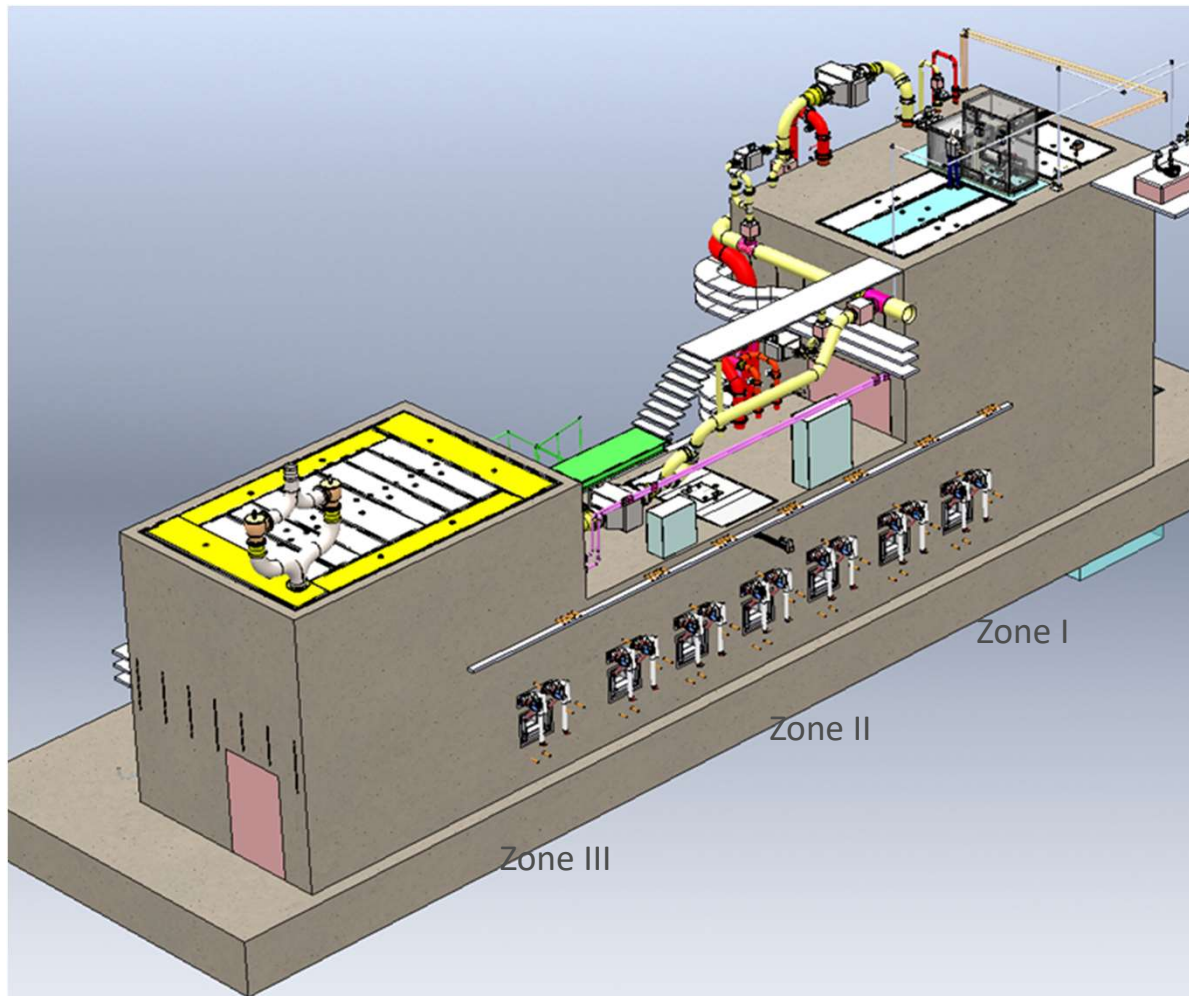


# Facility Design

- Designed in parallel with technology demonstration
- Allows Facility design to be refined based on lessons learned from the inactive demonstration Facility
- Supporting systems designed around the process
  - Building - height
  - Hot cell complex – footprint
  - Active ventilation systems – tailored around unit process
  - Service systems (heating, cooling, electrical and gases)
  - Integrated Facility design



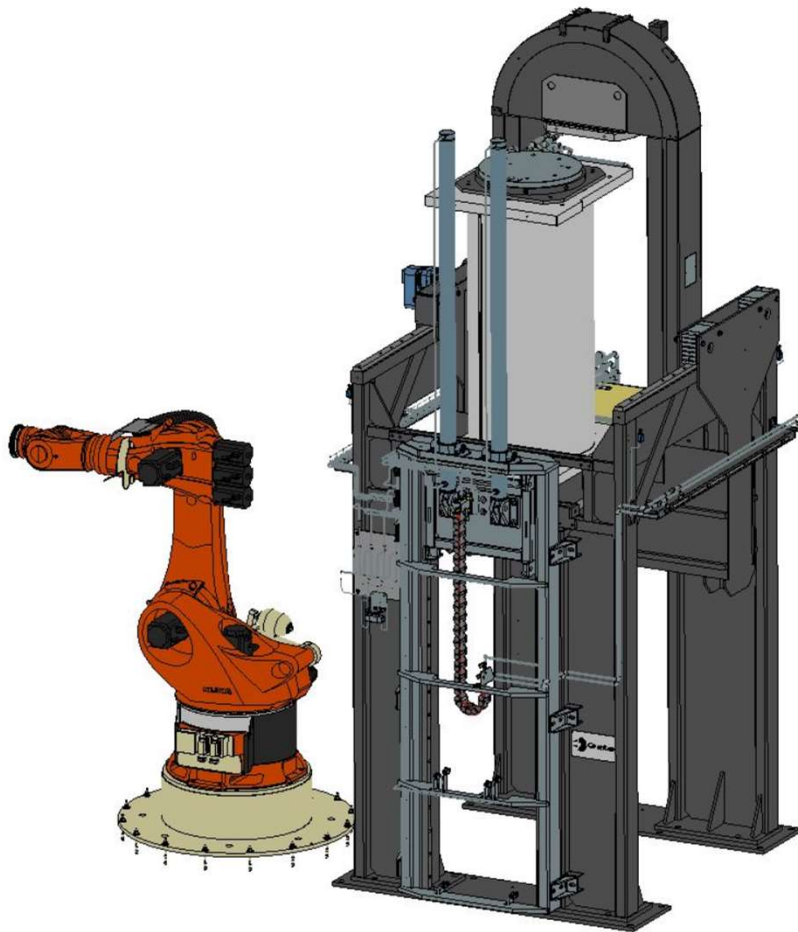
# Hot-cell design



Three zone hot-cell facility;

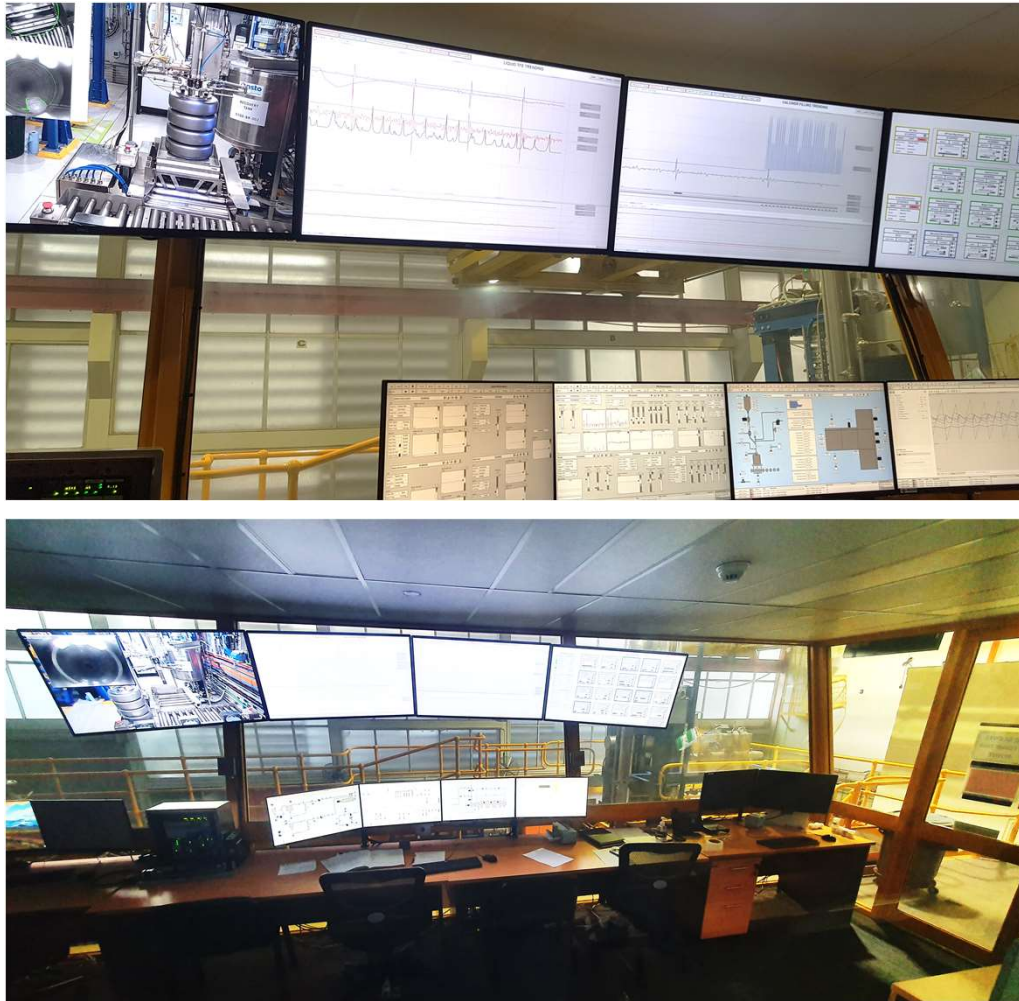
- I. High bay powder processing
- II. In-cell CAN process line
- III. Integrated HIP

# Integrated Hot Isostatic Press Design



- Configured for remote operations
- Integrated with loading/unloading of HIP canister
- Serviceability and recovery during operations
- HIP system – furnace for single 30 L canister

# Instrumentation and Control



- System architecture designed prior to deployment within the SyMo Facility
- Replicate instruments and performance
- Replicate remote operations



# Facility Construction

- ANSTO is the design authority
- Building and hot cell constructed by building contractor
- ANSTO responsible for:
  - Design
  - Procurement
  - Process fit-out
  - Pre-commissioning
  - Cold Commissioning
  - Hot Commissioning
  - Operational readiness

# Construction Phase



March 2019



# Construction Phase



**November 2019**



# Construction Phase



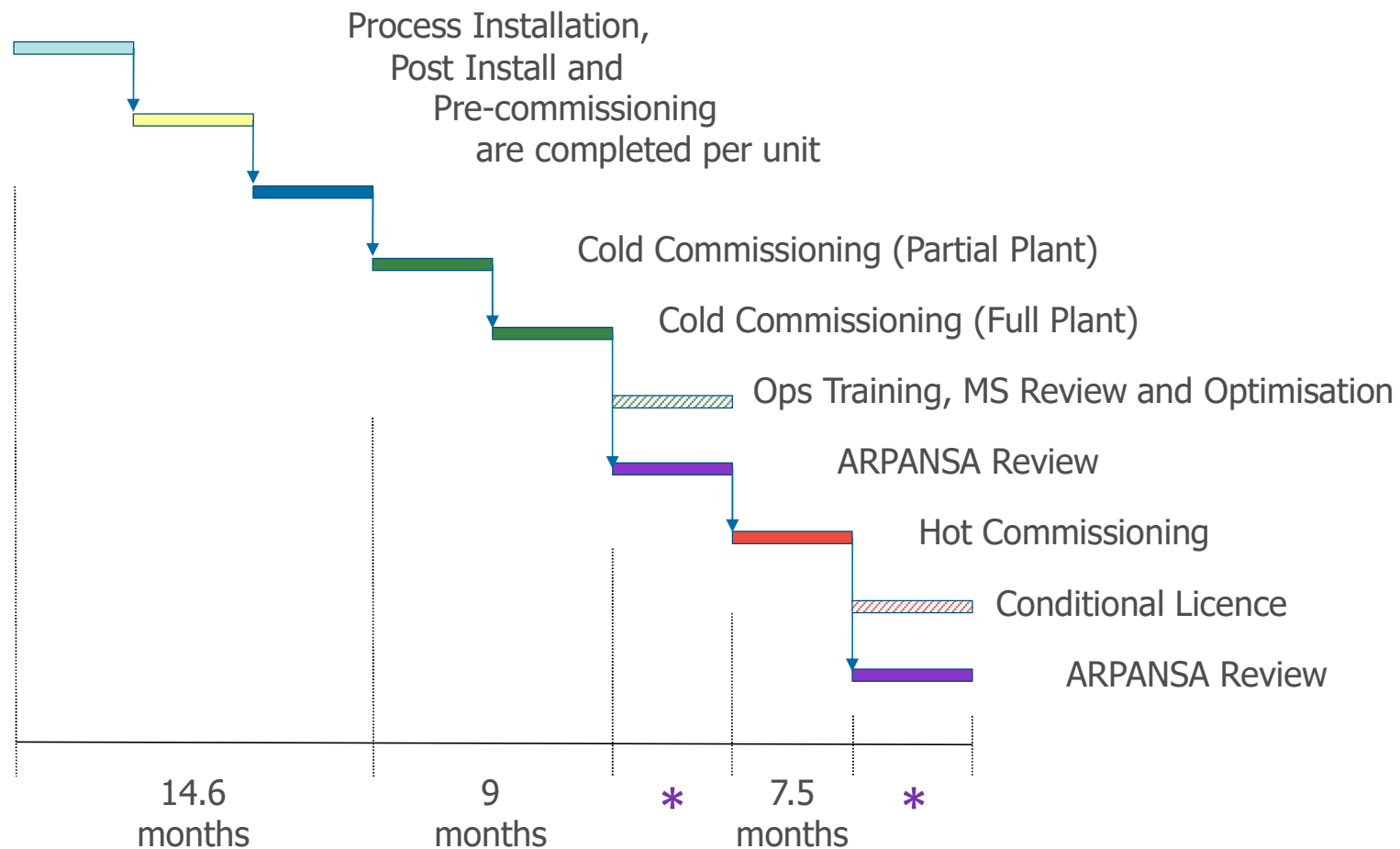
March 2020

# Operational readiness

# Commissioning Framework for SyMo plant

- Linked to ANSTO Values and WHS Strategy
- Risk based approach utilising ANSTO safety processes
- Simple, visual, effective and utilises ANM experiences
- Commissioning Plans use phases and release certificates to control scope of work for each task
- From unit / system level to integration of the whole plant
- Meets regulatory requirements - ARPANSA licence

# Commissioning Milestones



\* Externally determined with a high degree of variability

# Synroc in the Future



# Synroc Future applications

- Beyond Mo-99 waste
  - Nuclear: Immobilising Pu, Cs and pyroprocessing bearing wastes
  - Molten wastes from Gen-IV reactors
  - Spent fuel waste (HLW)

# Conclusion

---

- SyMo project encompasses engineering and R&D aspects
- Common engineering methods (Calciner, HIP and Scrubbers) have been safely used within a nuclear application
- ANSTO commissioning on track for 2025
- Further applications of tech beyond SyMo are being explored

# Further Information

- R. Holmes, A. Abboud, B. Bigrigg, D.J. Gregg, G. Triani, “ANSTO Synroc’s Inactive Engineering Demonstrator”, paper 19342, Waste Management 19 (WM’19), Mar. 2 - 7, 2019, Phoenix, AZ, USA.
- R. Holmes, D.J. Gregg, E.R. Vance, M. Smith, G. Triani, “Synroc Waste Treatment Facility for fission-based Molybdenum-99 production”, paper 19335, Waste Management 19 (WM’19), Mar. 2 - 7, 2019, Phoenix, AZ, USA.
- D.J. Gregg, E.R. Vance, P. Dayal, R. Farzana, Z. Aly, R. Holmes, G. Triani, “Hot Isostatically Pressed (HIPed) fluorite glass-ceramic wasteforms for fluoride molten salt wastes”, J. Am. Ceram. Soc. 103, 10, 2020: 5454-5469.
- D.J. Gregg, R. Farzana, P. Dayal, R. Holmes, G. Triani, “Synroc technology: Perspectives and current status, J. Am. Ceram. Soc. 103, 10, 2020: 5424-5441.
- R. Thunholm, J. Shipley, R. Holmes, D.J. Gregg, B. Bigrigg, P. Fleming, G. Triani, “Technology Maturation of Hot Isostatic Pressing for Nuclear Waste Treatment”, paper 20259, Waste Management 20 (WM’2020), Mar 8-12, 2020, Phoenix, AZ, USA.
- R. Holmes, A. Abboud, B. Bigrigg, D.J. Gregg, M. Deura, W. Townsend, P. Fleming, G. Triani, “Current Status of the Synroc Waste Treatment Facility”, paper 20263, Waste Management 20 (WM’2020), Mar 8-12, 2020, Phoenix, AZ, USA.

# Thank You!

