Pluto LNG startup
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Introduction

Objective:

• Provide an overview of challenges and solutions employed during commissioning and startup of Pluto LNG facilities

Pluto background

• Situated in Carnarvon basin off North West Australia
• Greater Pluto field contains 4.8 Tcf gas reserves
• 90% Woodside owned and operated
• Joint venture partners: Tokyo Gas (TG) & Kansai Electric (KE)
• Discovered in 2005, first LNG produced in 2012. Fastest ever development from discovery to first LNG
Pluto field and surrounds
Pluto facilities description - offshore

- Subsea wells (800 m water depth)
- Not normally manned offshore platform (85 m water depth)
- Flowlines: dual 20-inch 27 km pipeline from wells to platform
- Trunkline: 3 phase 36-inch 180 km pipeline from platform to shore
- Continuous mono-ethylene-glycol (MEG) injection to wells for hydrate inhibition
Pluto facilities description - onshore

- 1 x LNG train: ~4.3 MTPA, C$_3$/ Mixed Refrigerant (MR) process
- LNG / condensate storage and offloading
- 4 x 40 MW power generation
- Condensate stabilisation
- Nitrogen rejection unit (NRU) integrated with the fuel gas system
- Onshore MEG processing and export to offshore
- Effluent treatment plant (ETP) for treatment of produced water
Pluto startup logic

Offshore
- Pipeline pre-com
- Trunkline pressur’n
- Platform start up
- Start wells

Onshore
- Diesel gen & utilities
- First domgas
- GTGs
- ETP start up
- MEG first fill
- MEG Start up
- Frame 7 tests
- Compress or tests
- Hot water
- Acid gas removal
- Propane first fill
- LNG import
- LNG train Start up
Leveraging from experience

- Woodside’s third LNG train startup in 8 years but first greenfield LNG startup in 25 years
- Key personnel in team with experience from previous Woodside LNG train and MEG startups, including greenfield startups
- Integrated personnel from JV partners (KE & TG) into start up team, bringing experience of LNG tank and terminal commissioning
- Key vendors resident onsite for extended periods and integrated with Woodside team when required
- Site visits to other facilities to gain start up experience on units which were novel to Woodside
Improving on best practice

Improvements made to previous start up techniques

• Early commissioning of gas turbines and offshore facilities using domestic gas
• Air runs (rather than N\textsubscript{2} runs) on all compressors
• Air / N\textsubscript{2} drying (rather than defrost gas)
• Cool-down of tanks using LNG import
• Once through MR process for ethane generation
Challenges (1) – flare tower replacement

• Replacement of main flare tower required during commissioning period (design issue)

• Risk of delays to hydrocarbon introduction and overall startup schedule

• Small temporary flare constructed to allow progression of commissioning

• All startup activities carried out as planned. Impact of the flare tower on start-up schedule was mitigated
Challenges (2) – LNG tank cooldown

- Tank cooldown carried out using import from LNG carrier
- Cooldown experience from other projects and Pluto JVs utilised
- Allowed storage and loading facilities to be started in advance on LNG startup
- Cooldown carried out quickly (8 days) and without incident
- LNG & tank boil off gas used in startup of LNG train
Concerns:

- Significant complexity – startup of subsea system and 3 phase trunkline during LNG train startup
- Concerns regarding reliability of MEG (Mono-ethylene glycol) & ETP (effluent treatment plant) during start up period

Mitigations:

- Use of domestic gas for offshore pressurisation and commissioning
- Early MEG import allowed testing of MEG and ETP units
- Offshore personnel located at LNG plant for start up
- Trunkline flow assurance model integrated with facility control system to provide real-time liquid volume estimates during start-up
- Result - successful integrated start-up of offshore and onshore
Challenges (4) – ethane generation

• “Once through MR” process used for ethane generation

• Novel process utilising operational experience of mixed refrigerant composition management

• Sufficient ethane produced for LNG train startup within a few days, a significant improvement on traditional techniques

• Further information on “once through MR” available at LNG 17 poster session
Storage and loading flare

• During first ship-loading ice formation observed on storage and loading flare, halting loading operations

• Root cause was air-assist system which was installed to minimise smoke formation

• Air assist turned off and no further ice observed

• Flare tip re-designed to allow use of air without issue

NRU

• Lengthy start-up operation, spanning over several days

• Quality shift handovers and procedures essential

• Woodside worked with vendor to improve startup processes
• Startup considered a great success
• System utilisation in excess of 90% in second half of 2012
• Operation close to design capacity within 3 months of first LNG
• Testament to experienced team, detailed planning and innovative start-up methods
• Woodside continues to build on its proven start-up capability