UMATAC Industrial Processes

Alberta Taciuk Process (ATP) Technology – Recent Developments and Activities

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PRESENTATION TO:

28th Oil Shale Symposium October 13-15, 2008
Golden, Colorado

October 14, 2008

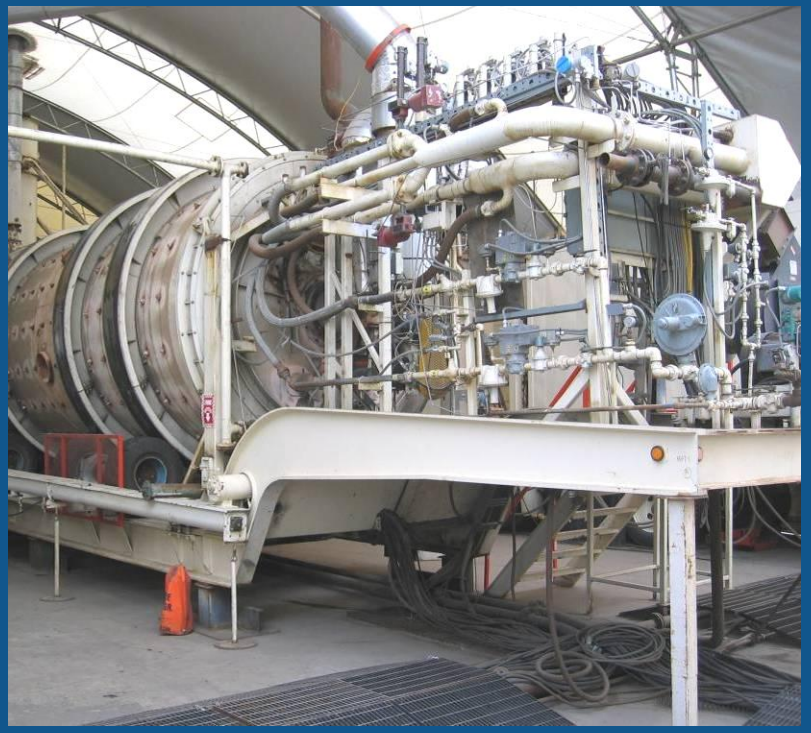
Agenda

- Introduction to UMATAC Industrial Processes
- ATP Technology Description
- ATP Technology Development History
- Stuart, Australia, Demonstration Plant Experience
- Recent Innovations, Developments, and Activities
- Questions

UMATAC Industrial Processes

Overview:

- Based in Calgary, Canada
- Engineering Offices
- Pilot Plant Facility, Laboratory
- Field Technical Services

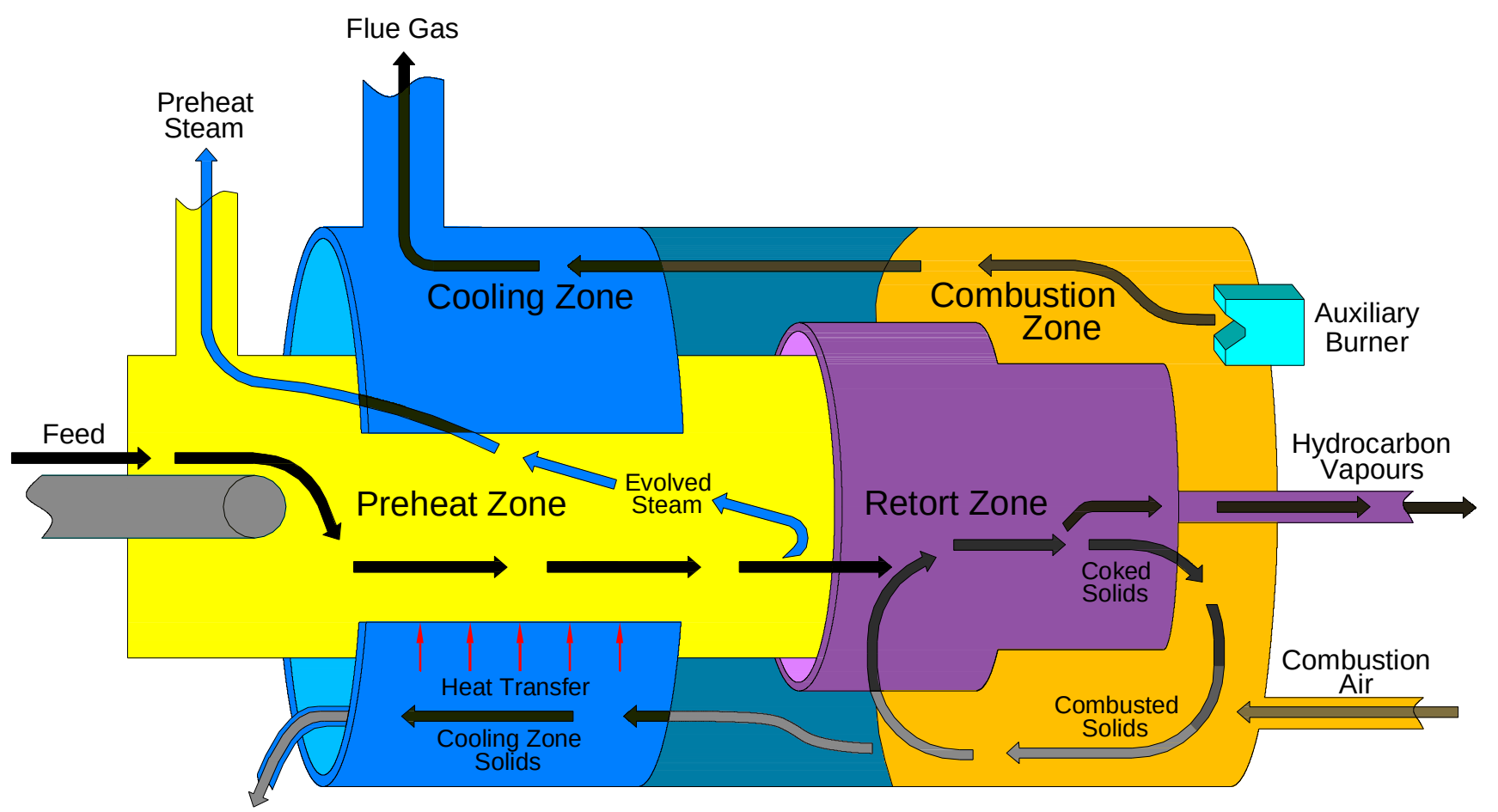


ATP60 Pilot Plant

UMATAC Offers:

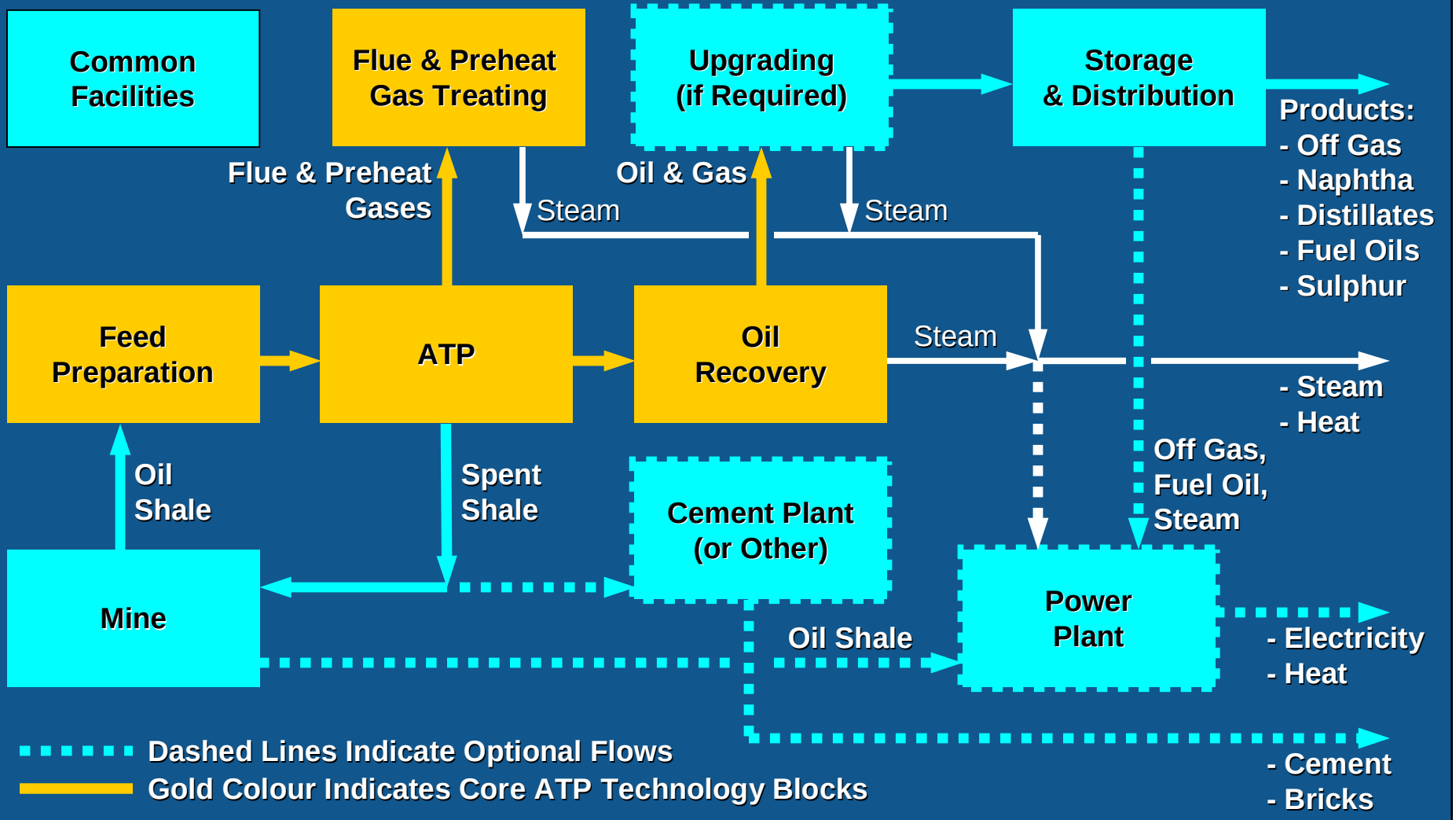
- Oil Shale Project Engineering
- Alberta Taciuk Process (ATP) Technology
- Oil Shale and Oil Sand Ore Evaluations
- Specialist Process and Mechanical Engineering
- Cooperation with Polysius AG (a ThyssenKrupp Company) for Rotary Kiln Heavy Fabrication Expertise

ATP Processor - Schematic



The ATP Processor

Flow Scheme – ATP System and Related Facilities



ATP Technology Development – 33 Years of Experience

1975 UMATAC Inception

1977 First ATP Pilot Plant Constructed

1978 – 1988: Oil Sand Pilot Studies and Developing Commercial Plant Concepts and Cost Estimates

1989 – 1992: Australia Oil Shale Pilot Studies

1991 – 1994: ATP60 Pilot Plant Built, Oil Sand Pilot Studies, and 10 t/h Commercial Hazardous Waste Clean-up Plant Constructed

1993 – 1998: Treatability Testing of Oil Sands and Shales from Numerous Locations

1996 – 2004: Stuart Stage I Oil Shale Demonstration in Australia - First Major Scale-up

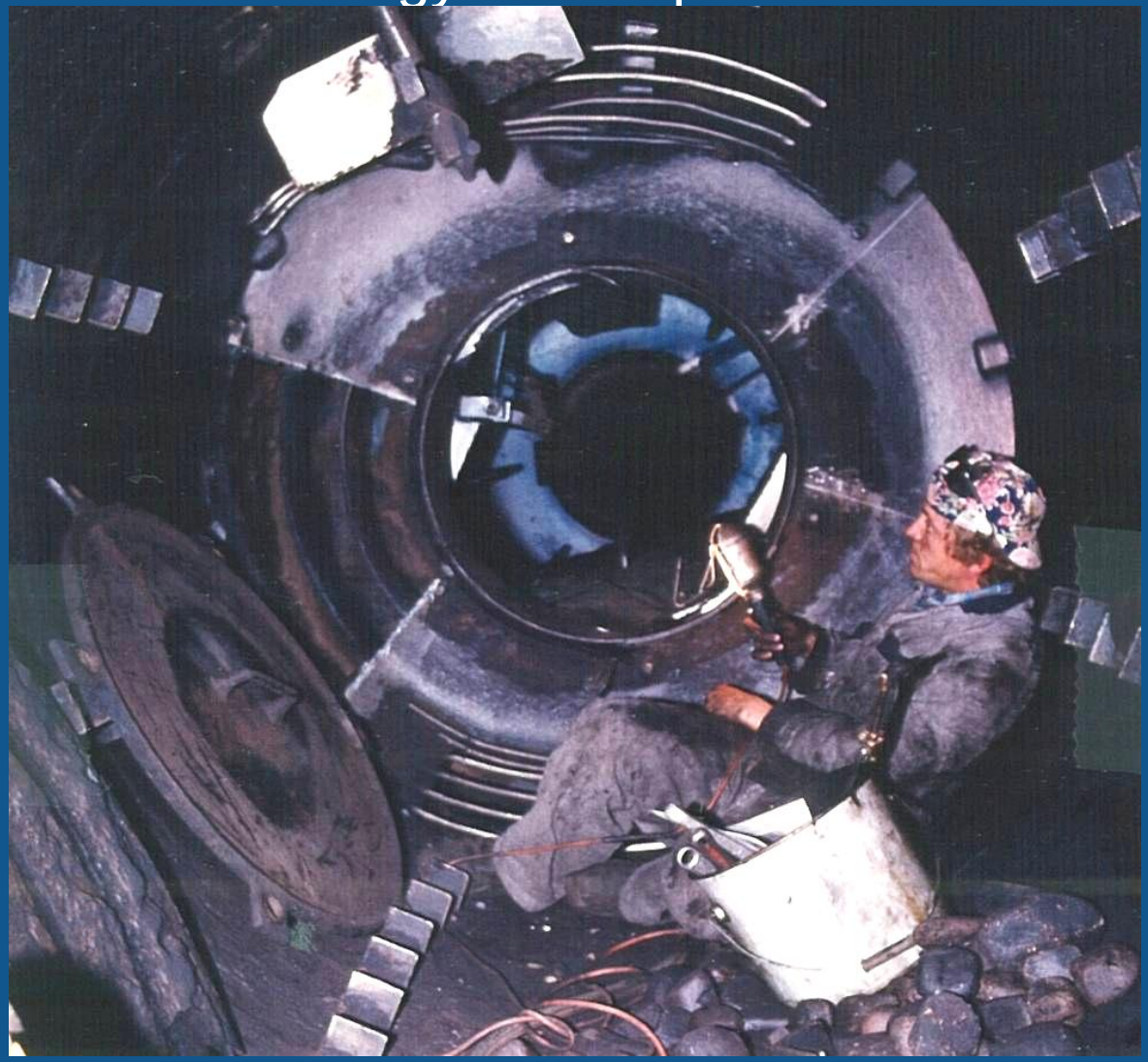
1999 – 2009: USA, Jordanian, Estonian, and Chinese Oil Shale Pilot Testing and Studies

2006 – 2010: Commercial ATP Plant Design & Construction in China

ATP Technology Development – 33 Years of Experience

First ATP Pilot Plant Construction – 1977
(William Taciuk on Left)

ATP Technology Development – 33 Years of Experience



1978 to 1994 Oil Sand Piloting

A Major Challenge Solving Technical Problems & Developing Commercial Plant Concepts and Cost Estimates

1986 to 1991 Australia Oil Shale Piloting and Engineering

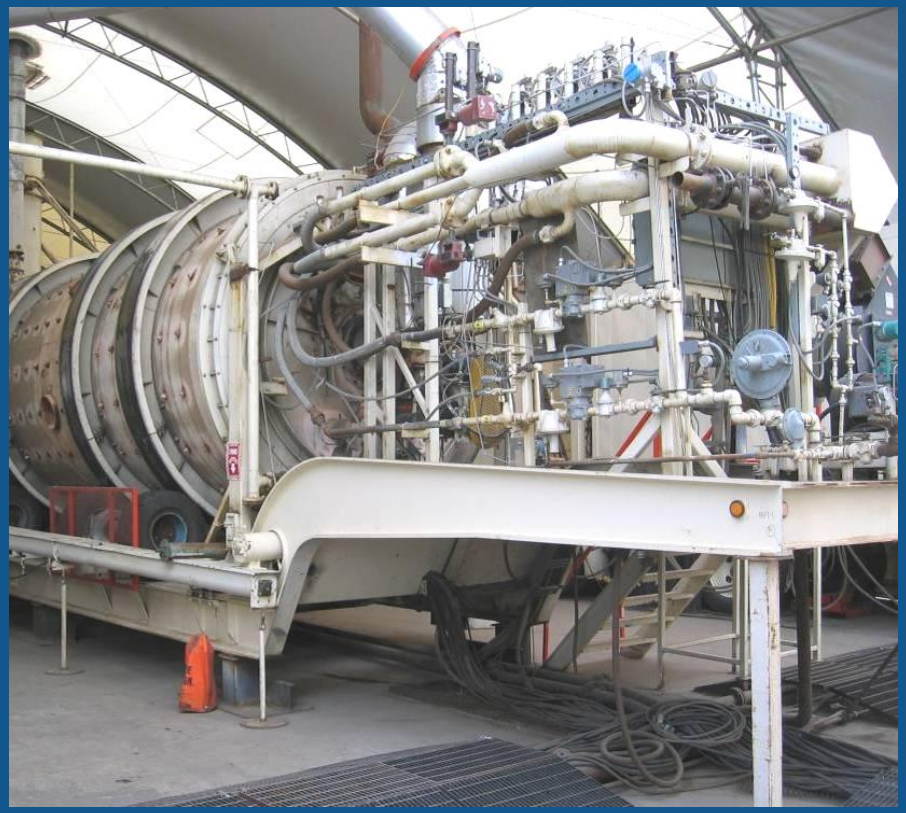
First Steps Towards Stuart Oil Shale Demonstration Plant

Preheat Zone Fouling During Oil Sands Piloting 1982

ATP Technology Development – 33 Years of Experience

1989 to 1995

10 t/h Hazardous Waste Cleanup ATP Processor Constructed. Operated in the USA on Four Superfund Sites



1991-

5 t/h ATP60 Pilot Plant Constructed. Currently Used for Major Pilot Plant Test Operations

ATP Technology Development – 33 Years of Experience

ATP Processor and Hydrocarbon Recovery Plant - Australia

1996 to 2004

Stuart, Australia, ATP Demonstration Plant Constructed in 1999 and Operated Until 2004

ATP Technology Development – 33 Years of Experience

ATP Processor Erection in China September 2008

1999 to 2008

Major ATP60 Pilot Plant Test Operations and Commercial Studies for Oil Shales Deposits in:

- USA
- Jordan
- Estonia
- Australia
- China

2008

ATP Facility Currently Under Construction in China

Feasibility Study for ATP Plant Located in Jordan

ATP Technology – Stuart Demonstration Plant Summary

ATP System Achieved Design Oil Yield

- 92% of MFA as C4+ oil, 98% recovery of C4+ into liquid products.
- 1.65 million barrels of oil produced from 2.6 million tonnes of oil shale.

ATP System Processed Above Nameplate Capacity

- Reached > 105% of rated feed throughput.

ATP Processor Capable of Processing Wide Range of Ores

- Operated on ore with 200% of design moisture.
- Operated on ore with grades ranging from 100 to >200 LT0M.

High Quality Hydrotreated Naphtha Product

- Nitrogen < 4 ppm, sulphur < 1 ppm.
- Received jet fuel certification (British Ministry of Defence Standard 91/91-3).

Quality Fuel Oil and Fuel Gas

- Fuel oil sold as cutter stock.
- Fuel gas used internal to plant to dry high moisture content oil shale.

ATP Technology – Stuart Demonstration Plant Summary

ATP Processor

- Scale-up (75:1) methodology was successful.
- Achieved design throughput and oil yield.
- Operated at 200% of design water load.
- Mechanical design proven to be robust. Problem areas identified.
- Preheat vent gas – odour problem. Thermal treatment retrofitted & was successful. Stuart much worse than other oil shales.
- Availability of ATP Processor was high – of 63 unplanned shutdowns only 7 were due to ATP Processor.

Mine, Feed Preparation, and Drying

- Mining plan - evolved to deliver steady feed to ATP.
- Crushing plant – initially not adequate. Retrofitted with roll crushers.
- Dryer – did not perform & was major odour source.
- Decoupling of feed preparation plant from ATP plant is important.
- Processed shale ash was suitable for direct disposal in mine as backfill.

ATP Technology – Stuart Demonstration Plant Summary

Oil Recovery & Upgrading

- Vapour scrubber design and scale-up proven.
- Discovered corrosion problem inherent in Stuart shale oil – much worse than other shale oils.
- Polymerization of oils is possible – usual industry precautions worked.
- Hydrotreating – industrial catalysts are adequate – no need to develop new catalysts. High nitrogen removal achieved, unit worked as designed.

Balance of Plant

- Problem areas needed to be rectified quickly.
- Equipment arrangement in ash handling system caused operational problems and required modification.
- Centrifugal off-gas compressor was sensitive to gas composition. Different machine selected for future plants.

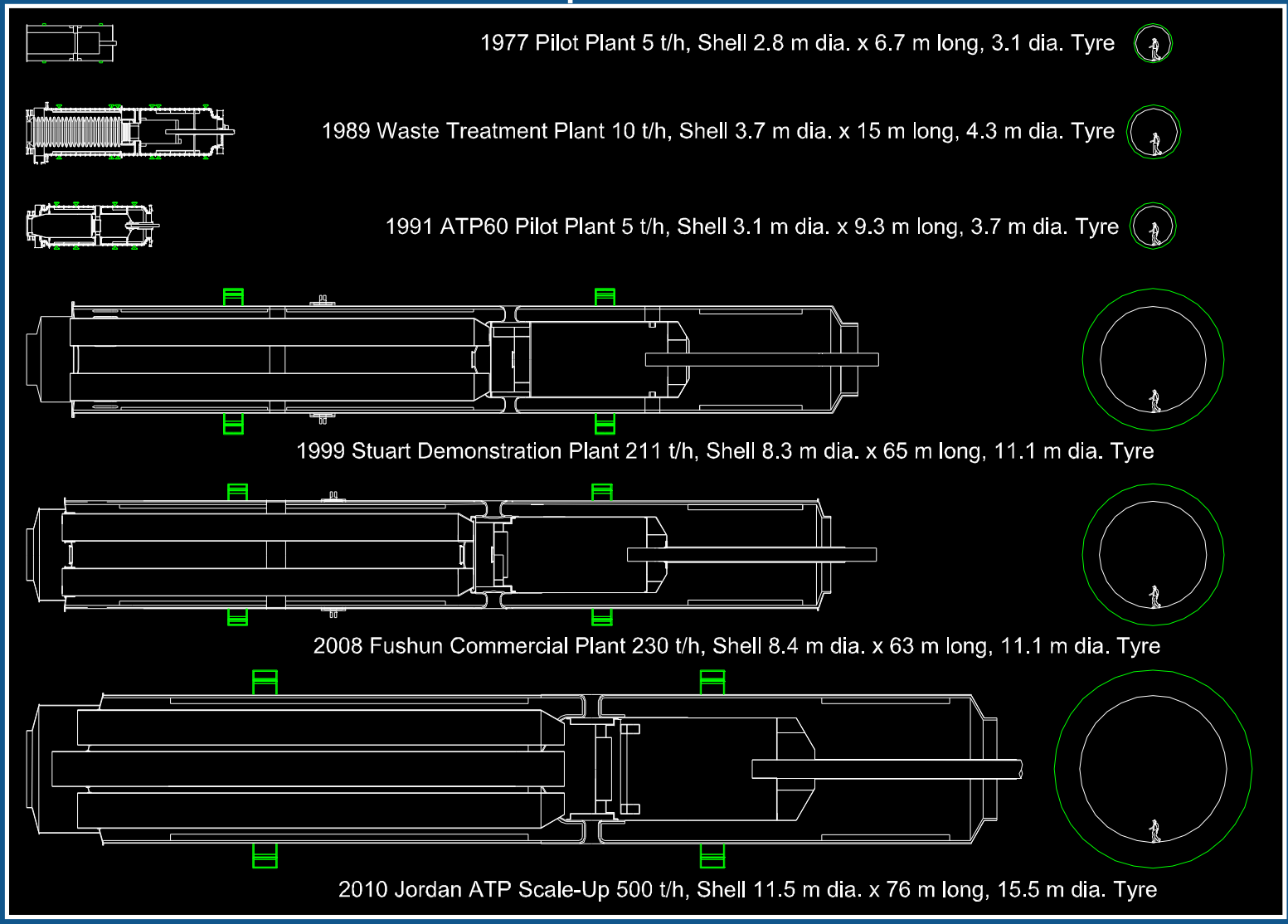
ATP Technology – Recent Process Developments

Scale-up

- Proved scale-up 75:1 at Stuart Australia Demonstration Plant.
- Similar size ATP being constructed in China.
- Designing 2:1 scale-up to 500 t/h per ATP Processor for Jordan.

Larger Capacity Plants Developed In Increments to Reduce Risk

ATP Processor Scale-up 1977 to 2010



Process Scale Up – In Real Terms

Five People Inspecting the ATP60 Pilot Plant Retort Zone

Six People Working in the Stuart Demonstration Plant Retort Zone

ATP Technology – Recent Process Developments

Increased Thermal Performance

- Previous plants implemented heat recovery from:
  - ✓ Hot solids inside ATP cooling zone (heat recovery from 750 to 400°C).
  - ✓ ATP hydrocarbon vapours (steam generation from hot oils).
- Implementing further recovery of waste heat from:
  - ✓ ATP spent solids (heat recovery from 400 to 150°C).
  - ✓ ATP flue gas (heat recovery from 365 to 150°C).

Result is 15% Lower Fuel Consumption for ATP in China

ATP Technology – Recent Mechanical Developments

Improved Mechanical Reliability of ATP Processor and ATP System

- Eliminated retort rear supports (maintenance issue).
- Reverted to previously piloted refractory & lining system.
- Wear plates installed in previously identified high wear areas.
- Revised equipment selection and specifications for certain equipment (eg. off gas compressor).

Incremental Improvements

ATP Technology – Recent Mechanical Developments

Mechanical Scale-up and Support Tyres

- Proved scale-up and mechanical reliability of 8.3 m diameter ATP Processor at Stuart Demonstration Plant – very robust design.
- Stuart project shipped 11.1 m diameter support tyre as single piece – a transport constraint for larger machines.
- Fushun, China project cast 11.1 m dia. tyres in 180° segments that were welded together and machined to final dimensions and tolerance on-site – pilot testing a solution to a future scale-up constraint.
- Scale up to 500 t/h ATP requires ~15.5 m diameter tyre and 11.5 m diameter shell.

Scale-up Obstacle Removed For Larger Units

Single Piece (top) vs. Segmented (bottom) Tyre Transport – both 11.1 m Diameter

On-Site Tyre Welding & Machining

Weld Preparation

On-Site Machining by Self Leveling Machines (SLM)

Current Major Activities

Jordan, Al Lajjun ATP Project Feasibility Study

- ✓ ATP System engineering – process design, PFDs, PIDs, cost estimation.
- ✓ ATP Processor engineering – two 500 t/h capacity ATP trains.
- ✓ ATP60 test program – new bulk oil shale sample.
- ✓ Reserves estimate, logistics, oil upgrading, power plant, and environmental studies.

China, Fushun ATP Project

- ✓ ATP Processor fabrication and construction underway.
- ✓ Major equipment ordered.
- ✓ Detail engineering and plant construction in progress.

Ongoing Opportunities and Investigations

- ✓ US and other oil shales, oil wet oil sands, coal pyrolysis.

Fushun, China, Construction Photos

ATP Processor Centre Support – Offloading From Ship and Road Transport Inside China (Fabricated in Malaysia)

Fushun, China, Construction Photos

Support Tyre Placed on Outer Shell (Shell Fabricated in China, Tyre Cast in Czech Republic)

Ash Recycle Assembly (Fabricated in Malaysia)

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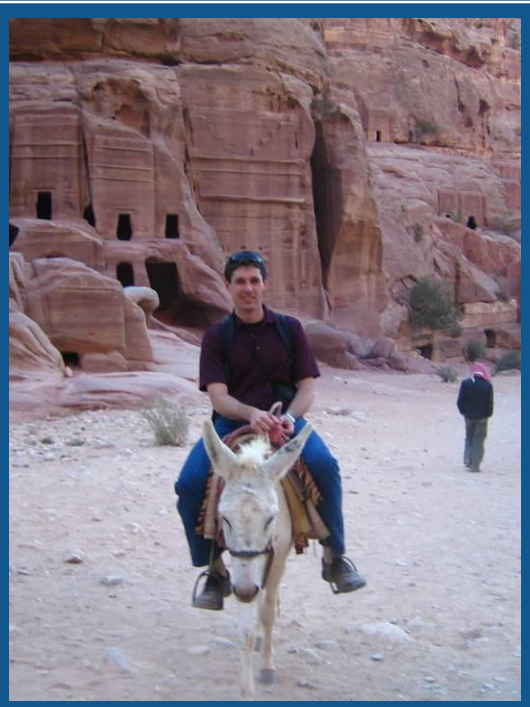
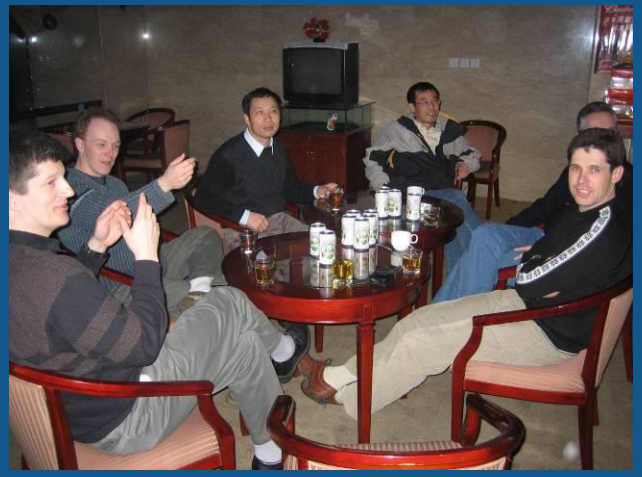


Questions?



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