



Nonmetallic Deployment for Water Injection

Expanding the Envelope of Nonmetallic for High Pressure Applications

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Capacity of 12 MMBD

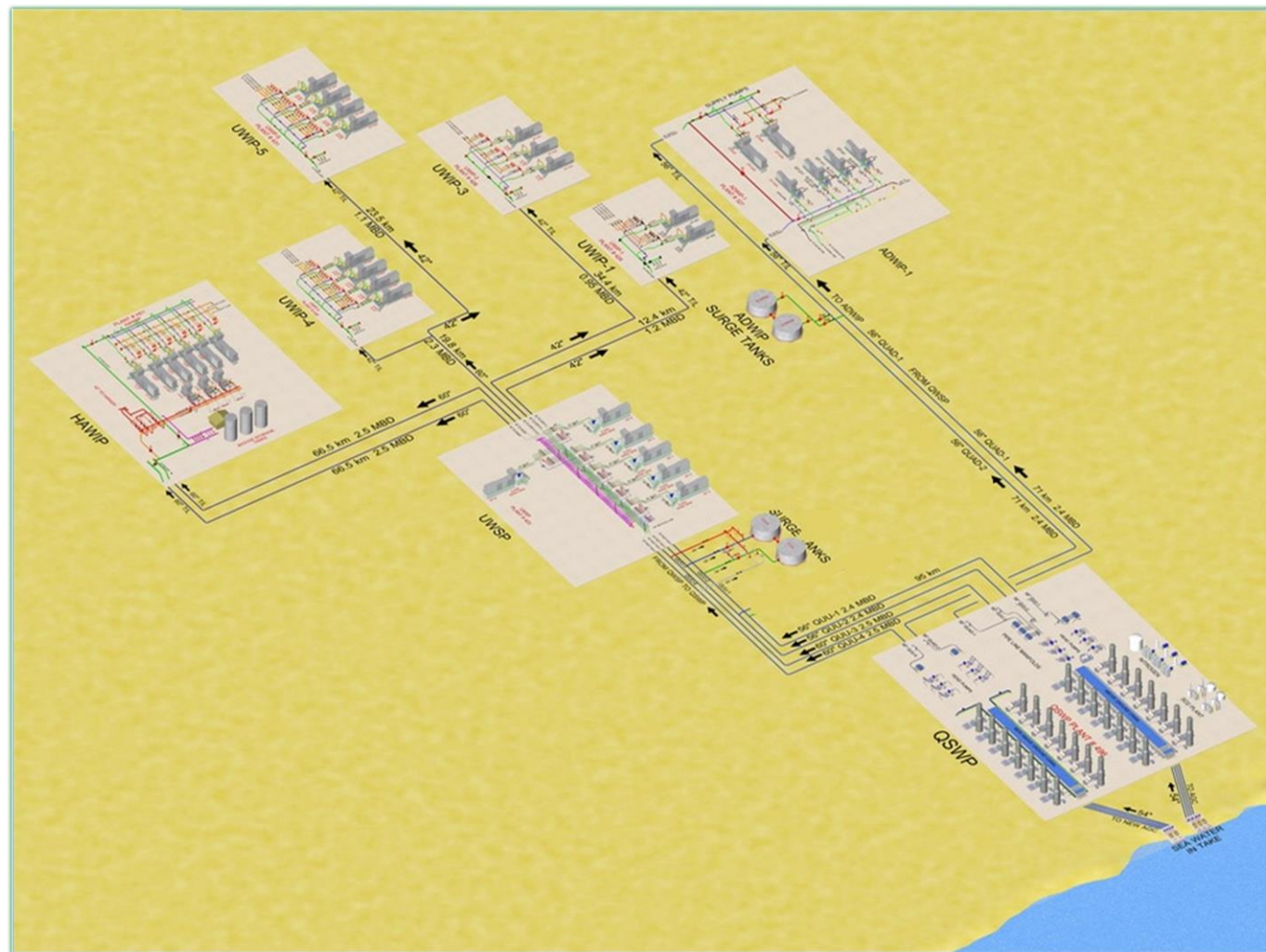
Transported through 6 shipping lines

Piping network = 1,900 KM

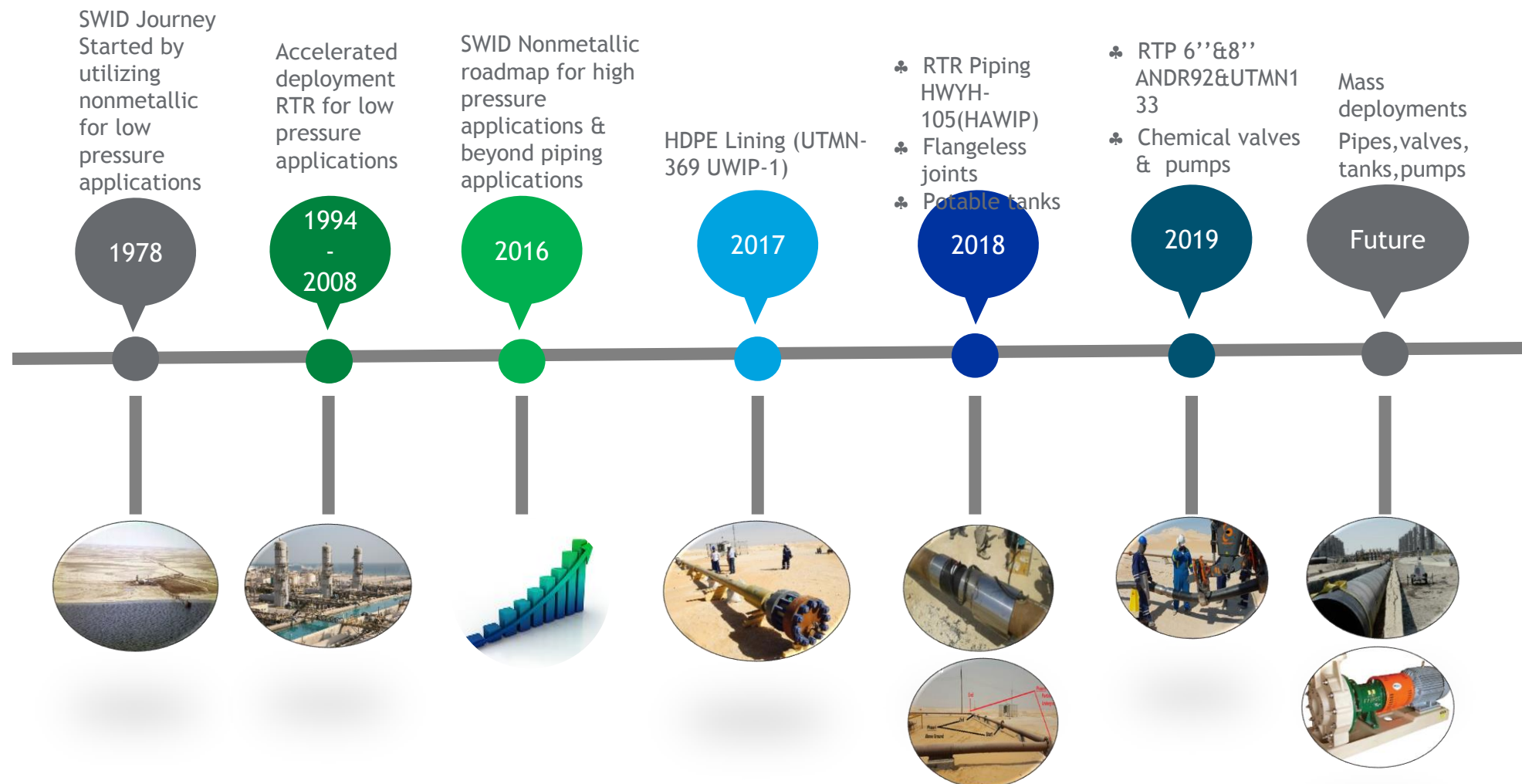
Size range 8-60" diameters

Most piping are not scrapable

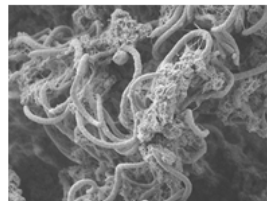
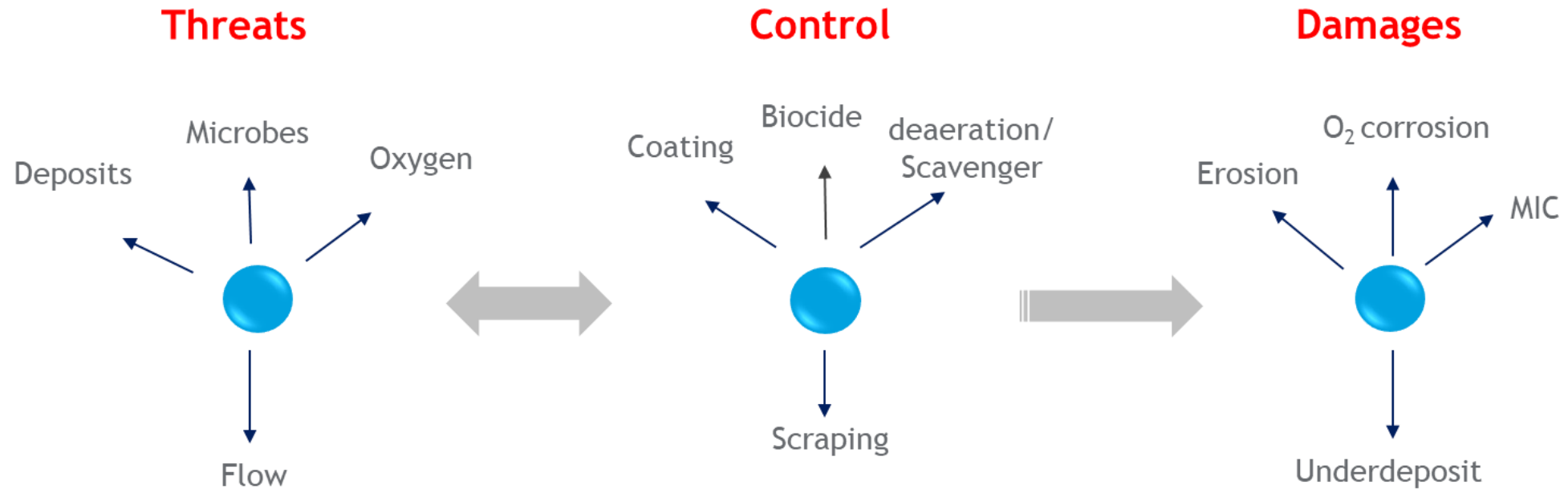
65% of the piping are underground



SWID Journey in Deploying Nonmetallic



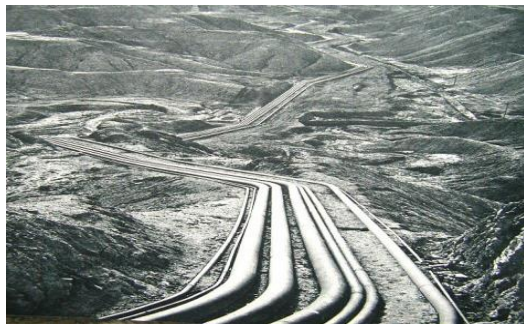
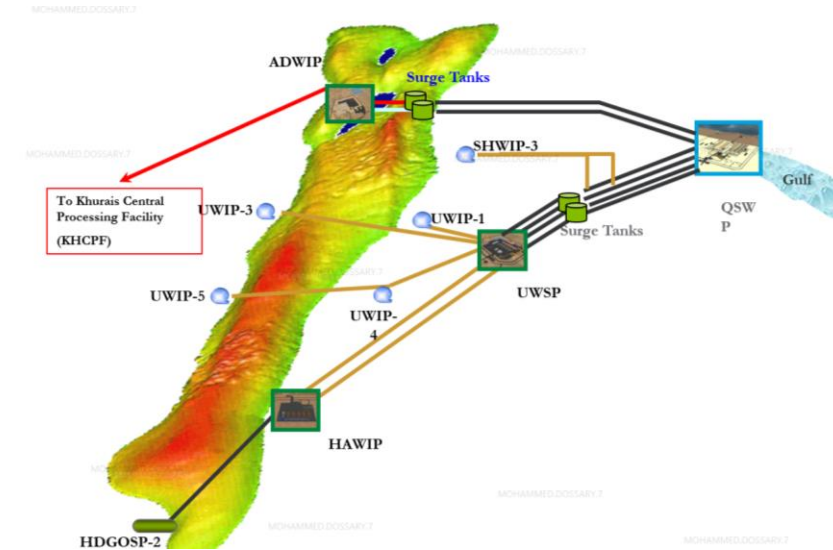
Internal Corrosion Model



Ref: Dr F Abbas

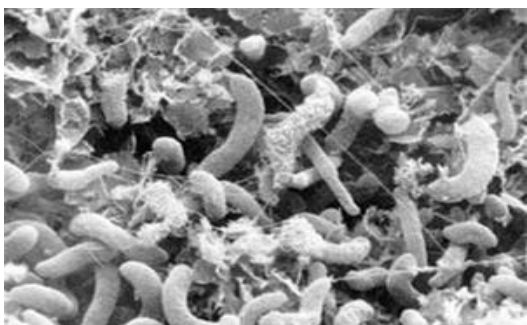
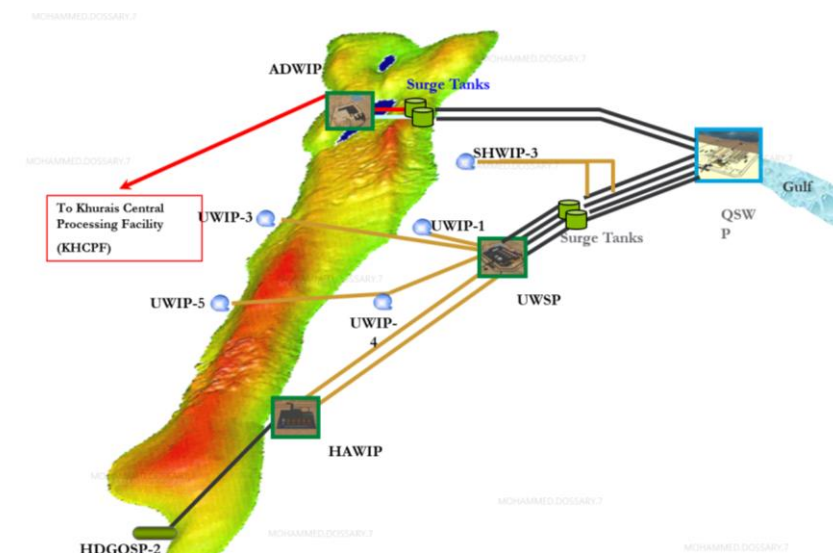
Integrity

- θ Girth weld locations: weakness points/different corrosion potential.
- θ Pediment Failure mode: leaks at the weld joints/HAZ.
- θ Pipelines coating has a life cycle.



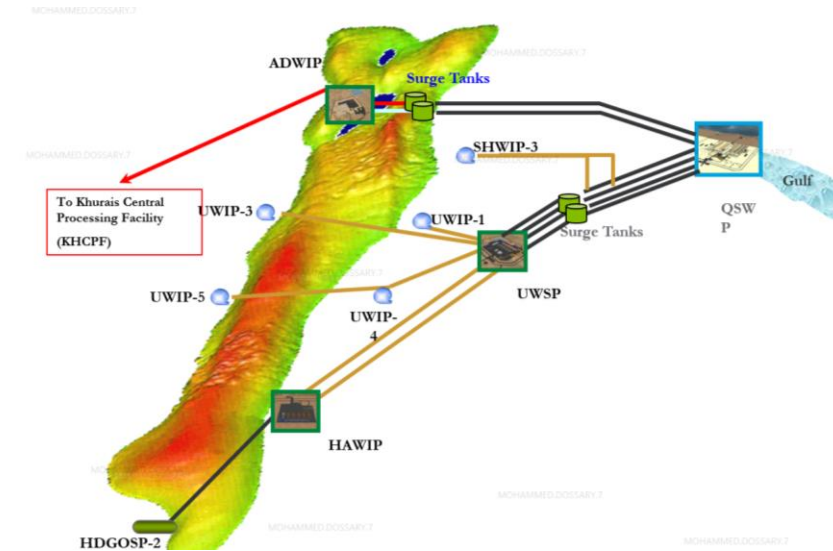
Operational/Maintenance

- θ MIC is one of the corrosion root causes in seawater injection.
- θ Biocide: Common method to preclude bacteria growth.
- θ Sleeves is the current method: impairs coating integrity.



Inspection

- θ Challenges to reach and inspect coated telescopic piping.
- θ Test holes are the current inspection method for underground piping.
- θ Off plot pipelines have inadequate detection programs, including the coupons.



Failure Case on Metallic Coated Piping:

Plant shutdown due to a pinhole leak in the main piping header 42” supplying that facility

Challenges:

- θ The piping is underground & underneath a highway.
- θ The leak was exactly with the portion underneath the road.
- θ It was quite difficult identifying the leak point.
- θ The repair had to be executed within a short period of time.



As an interim solution: the portion has been replaced with a new coated pipe without impacting the road traffic.
As a permanent solution: the pipe is to be replaced using nonmetallic application (HDPE liner) instead of coating.

Deploying nonmetallic applications can overcome all metallic piping challenges

The followings three (3) applications are the common one to cover in our presentation:

Reinforced Thermosetting Resin Piping (RTR)

High Density Polyethylene Liner (HDPE)

Reinforced Thermoplastic Piping (RTP)



Successful Technology Deployment to enhance System Integrity

Reinforced Thermosetting Resin Piping (RTR)

- θ The first time ever, RTR utilized for high pressure application
- θ design pressure up to 3,000 psig in diameters up to 10 inches.
- θ Under six month pilot testing





Successful Technology Deployment to enhance System Integrity

Reinforced Thermosetting Resin Piping (RTR)

Advantages:

Corrosion Resistance & lightweight
 Low Installation & Maintenance Cost
 Excellent Abrasion Resistance

Limitation:

Limited sizes to handle high pressure applications
 Sensitive to high temperature & operational upsets

DN (in inches) vs. Pressure rating (in PSI)							
DN	750	1000	1250	1500	2000	2500	3000
4	Green	Green	Green	Green	Green	Grey	Grey
6	Green	Green	Green	Green	Grey	Grey	Grey
8	Green	Green	Green	Green	Grey	Grey	Grey
10	Green	Green	Green	Green	Grey	Grey	Grey
12	Green	Green	Green	Grey	Grey	Grey	Grey
14	Green	Grey	Grey	Grey	Grey	Grey	Grey
16	Green	Grey	Grey	Grey	Grey	Grey	Grey



Successful Technology Deployment to enhance System Integrity

High Density Polyethylene Piping (HDPE)



- } HDPE lining replacing FBE coating in ongoing projects (replace/rehabilitation)
- } Started with all underground piping crossing highway or railway
- } Different Jointing techniques utilized (coupling & flanged connections)





Successful Technology Deployment to enhance System Integrity

High Density Polyethylene Piping (HDPE)



Advantages:

- It has the lowest repair frequency per km of pipe per year
- HDPE is generally used for high pressure applications ranging from 3.2 to 25 bar, in all sizes.
- There is no need for the FBE coating, and all risks associated with coating failures can be all eliminated.

Limitation:

- It is sensitive to chemical additives, or high temperature
- It requires special flanges to install (rounded face flanges)
- It has some maintenance cost as it requires regular venting to maintain its healthiness & reliability.
- HDPE lining requires piping surfaces in a good condition to install.



Successful Technology Deployment to Enhance System Integrity

High Density Polyethylene Piping (HDPE)



Successful deployment (UTMN-369):

- **Pilot Objectives**
 - Rehabilitate injection lateral
 - Stop internal corrosion and leaks
 - Qualify rehabilitation process
 - Qualify Rotolining capabilities for fittings
 - Qualify WTEF flangeless connector





Successful Technology Deployment to enhance System Integrity

High Density Polyethylene Piping (HDPE)



Custom Liner Pipes Designed & Manufactured



Liner Pipes Delivered to Site



Pipes welded together in long strings



Liner is bigger than inside of host pipe



Over-Sized liner temporarily reduced and installed in host pipe



Sections completed with WTEF flangeless connectors and flanges



Successful Technology Deployment to Enhance System Integrity

High Density Polyethylene Piping (HDPE)

- } Bolt Up
- } Hydro Test
- } Handover to Operations for startup





Successful Technology Deployment to enhance System Integrity

Reinforced Thermoplastic Piping (RTP)

- 8" RTP Pipe rated at 3000psig Deployed-First time in the world
- 6" RTP Pipe Rated at 3000psig Deployed-First time in the Company
- Hydrotested at 4500psig.





Successful Technology Deployment to enhance System Integrity

Reinforced Thermoplastic Piping (RTP)

Advantages

- } Easy & fast installation compared with CS Piping & HDPE lining
- } Fully corrosion resistant
- } Flexible with reusability feature





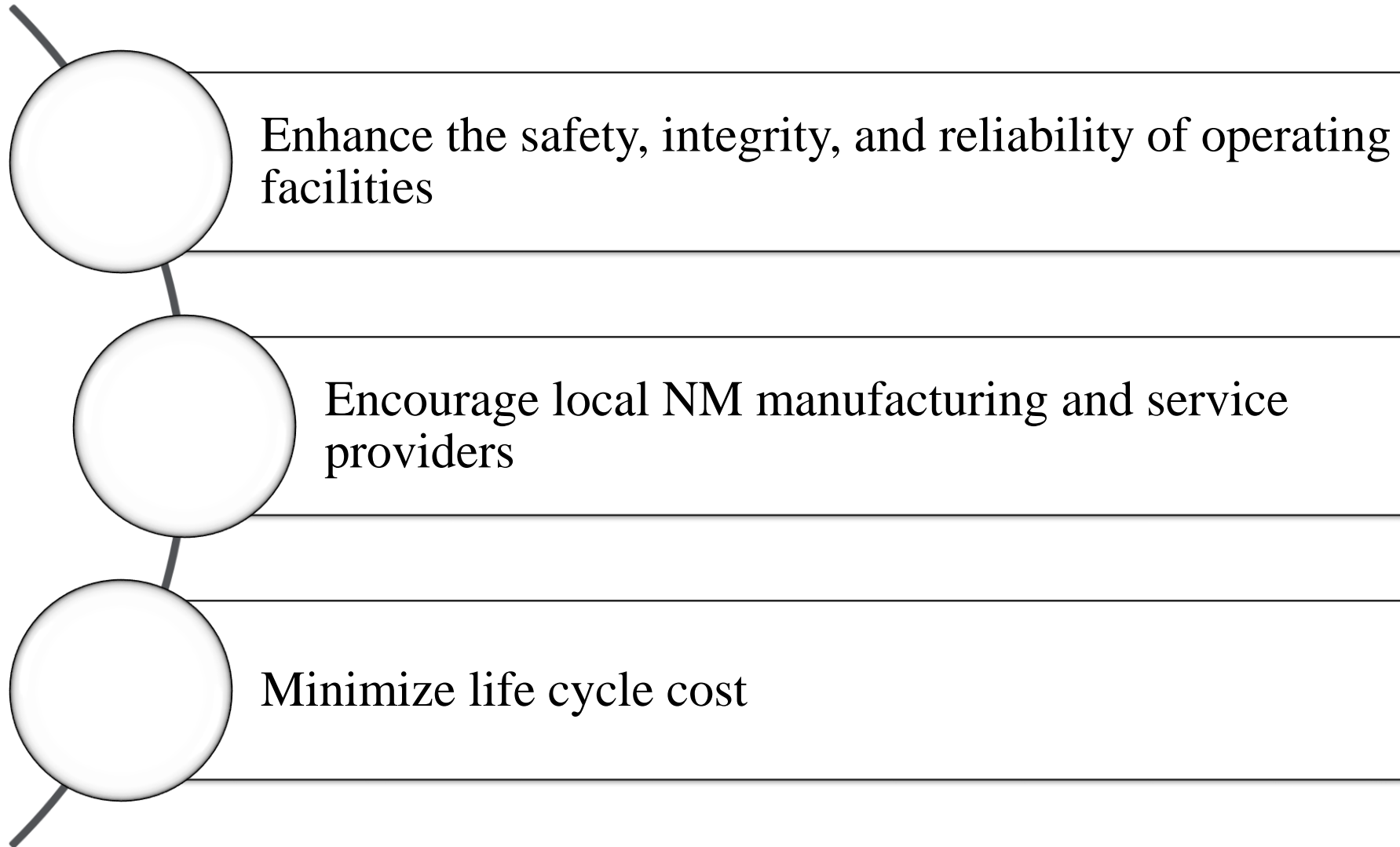
Successful Technology Deployment to enhance System Integrity

Reinforced Thermoplastic Piping (RTP)

Limitation

- Relatively high CAPEX compared with CS piping & HDPE lining
- It is only available with small sizes (6" & 8") for HP application.
- It requires metallic joints to install: potential corrosion points
(every 500 meter there is a metallic Joint)







Ultimate Goal
Utilize nonmetallic
wherever applicable.

Thank You



where energy is opportunity™