

Handling and **S**hipping of **DRI**

Ground Transportation of **DRI**

Rail Road and Truck Shipping

- RR shipping is possible. HYLSA has shipped from Puebla to Monterrey (1,000 km) in open gondolas more than 120,000 tons/y.
- Truck shipping is possible without any problems. Also HYLSA has been shipping DRI in dump trucks for many years without any incident.

Ocean Shipping of **DRI**

Shipping warehouse

- Product delivered to the warehouse is limited to 2000 tons at any one time.
- Product is stacked in four separate piles to allow cooling below 50 °C.
- DRI temperature is monitored daily inside the warehouse. Loading is not permitted if DRI temperature exceeds 50 °C.
- Average residence time prior to shipping is 10 to 20 days with an average DRI temperature of 40 °C.
- CIL considers that DRI “aging” in the warehouse is critical for safe ocean transport.

Ocean Shipping of **DRI**

Shipping vessels

- The preferred vessels have McGregor-type hatch covers and CO₂ fire fighting system in each hold of the ship. Prime requirement during rainy season to keep DRI dry.
- The average shipping volume per vessel is around 20,000 to 30,000 metric ton.
- A “competent authority” is appointed to certify that the vessel is safe for carriage and that the DRI to be shipped is stable.

Ocean Shipping of **DRI**

Shipping vessels

- On arrival, prior to loading, the vessel is inspected by a competent authority to verify :
 - 📄 All holds are clean and dry.
 - 📄 Electrical fans and cargo lights are disconnected.
 - 📄 CO₂ fire fighting systems are verify in all holds.
 - 📄 All hatches are hose tested to ensure that there are no leaks from hatch covers or opening.
- After completion of the test, a certificate of fitness is issue by the competent authority and guidelines for safe shipping and emergency procedure are given to the Master of the vessel.

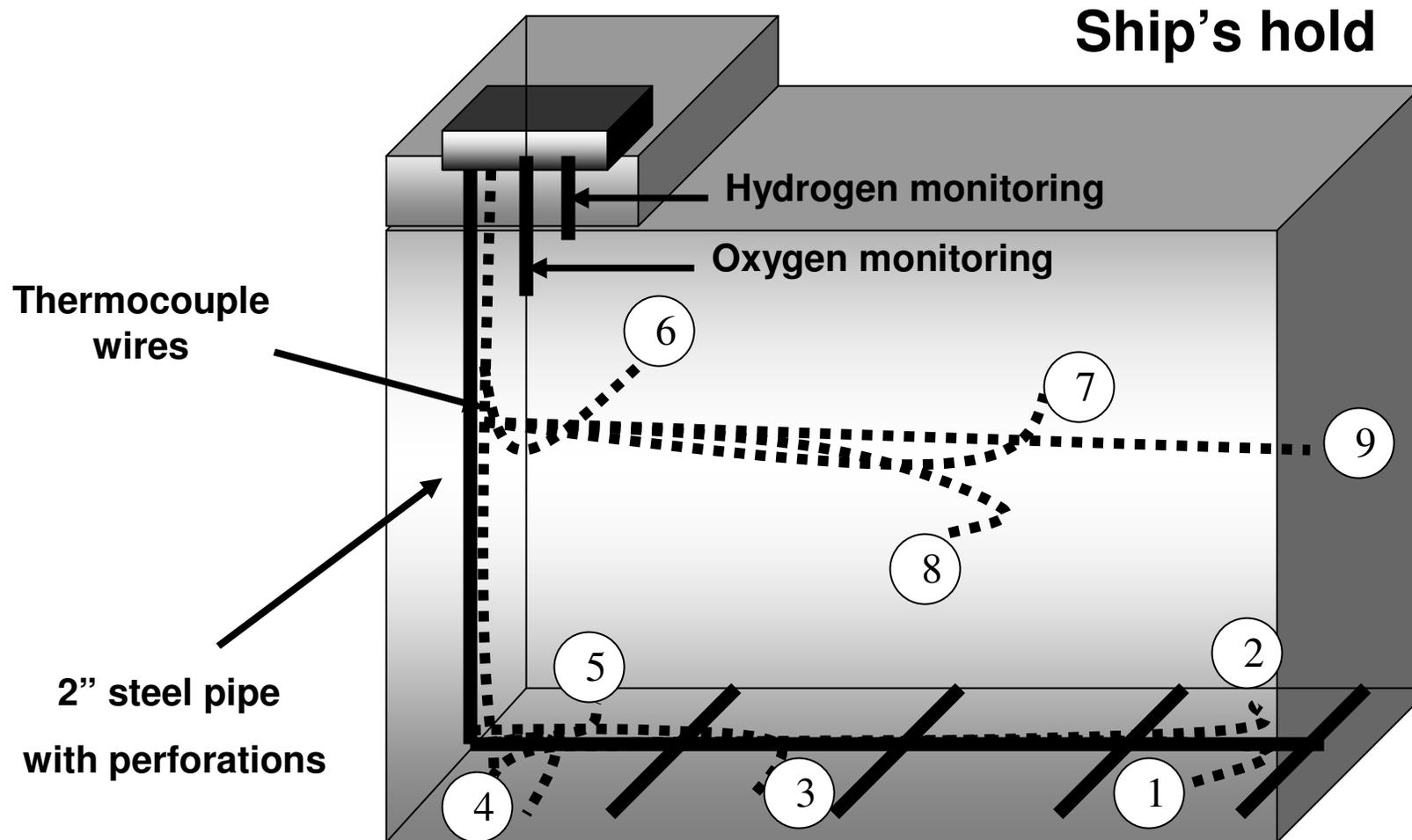
Ocean Shipping of **DRI**

Loading and ship preparation

- Before loading DRI, the floor of each hold is wired with thermocouples at specific locations for monitoring during the voyage.
- When about 50% of the cargo has been loaded a second layer of thermocouples is placed in each hold.
- Steel pipes with holes along their length are also installed in each hold for nitrogen purging of the cargo after loading.
- At the end of loading, two gas sampling lines are installed, one for oxygen and the other one for hydrogen monitoring.

Ocean Shipping of **DRI**

Loading Preparation



Ocean Shipping of **DRI**

Loading and ship preparation

- The oxygen monitoring line is suspended just over the cargo and the hydrogen monitoring line about two feet below the access cover.
- The hatches of all holds are sealed with marine tape on openings and seams, ventilators are shut tight and covered.
- N₂ is pumped through the steel pipes on each hold to displace air and create an inert atmosphere. After completion of inerting the hold, the N₂ supply line is disconnected and the inlet to the hold sealed.
- A Supercargo accompanies all voyages of DRI to ensure safe carriage and cargo stability at sea.