Problems experienced when dealing with the decommissioning of NORM contaminated Oil Production Installations and Vessels

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Types of Oil Production Facilities.

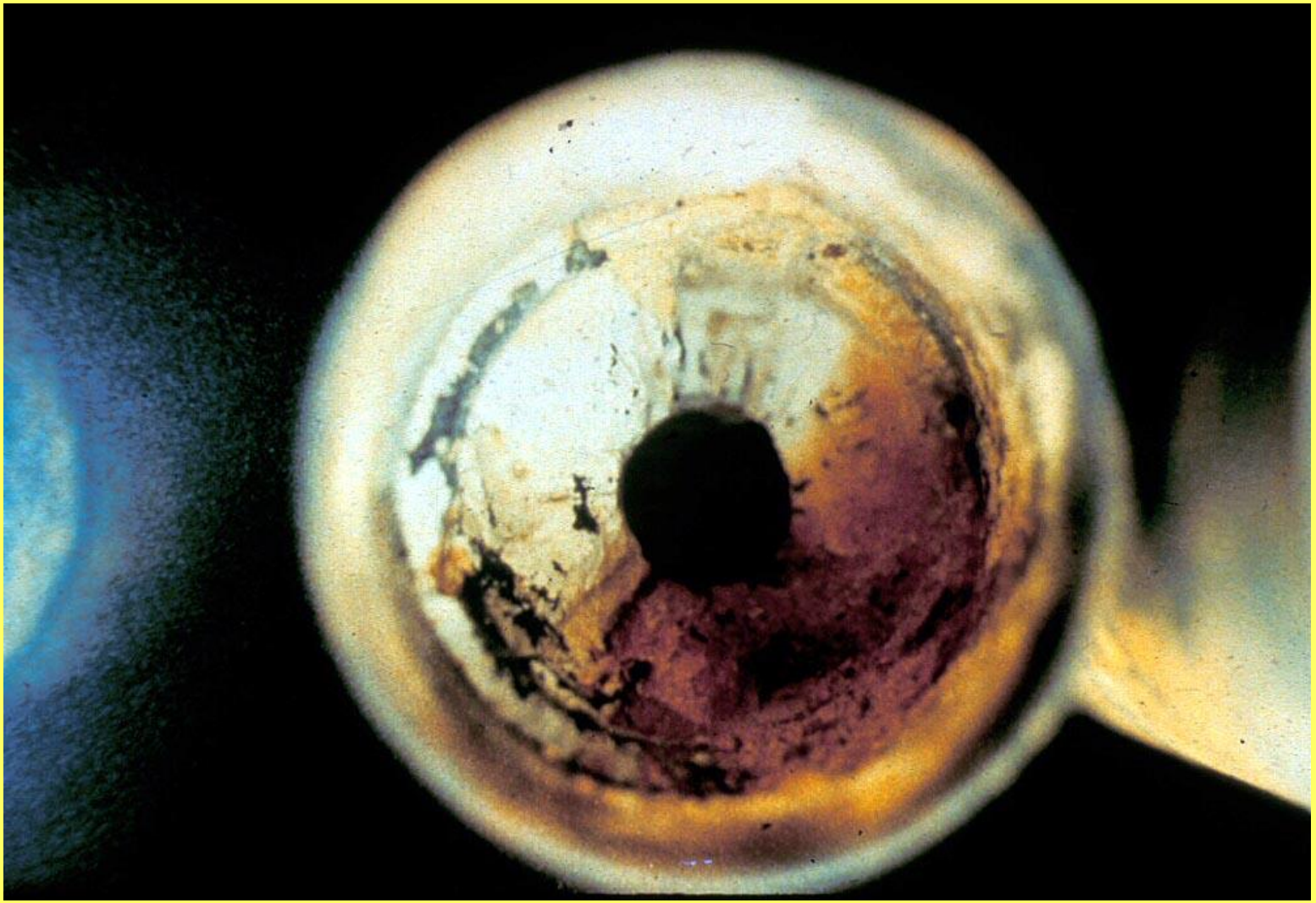
- Platforms – rigid structure sitting on the sea bed above the oil field or coupled to a satellite subsea well head some distance away through a flexible riser.
- Floating Production Storage and Offloading (FPSO) vessel connected to several subsea well heads through a flexible riser.

Source of NORM

- Oil and Gas bearing rock formations contain naturally occurring uranium and thorium
- Rock formation also contains formation water which is produced along with the oil.
- Radium dissolves in the formation water as radium chloride.
- Also dissolved in formation water are barium, strontium and calcium.

NORM waste in Oil Production

- Scales - Hard deposits, very resistant to chemical removal, which can be so thick that they block a pipe.
- Sludges – These build up at the bottom of vessels. Not always soft, can be almost solids and often have a high hydrocarbon content.



Formation of Scales

- Generally associated with the injection of seawater to maintain field pressure.
- Seawater contains sulphate which combines with the barium, strontium and calcium in formation water to produce sulphate scales as the pressure and temperature reduce during production.
- These co-precipitate and concentrate the radium from the formation water.

Formation of Sludges

- To avoid scale formation scale inhibitors are injected. These either stop the scale forming or, more commonly, stop them adhering to the metal surface. The scale particles can then be deposited onto the bottom of vessels.
- Also there are sand and clay deposited from the rock formation which are radioactive.

Activity levels & Doserates

- Scale activity levels can rise to over 100 Bq/g of radium 226. Ratio of radium 226 to 228 is very variable but on average will be 2:1
- Level of equilibrium varies.
- Sludge activity levels much lower normally.
- Doserates recorded up to 80 µSv/h inside both vessels and when pulling tubulars but generally much lower.
- Generally the main hazard is from ingestion.

Problems – Platforms and FPSOs

- Full extent of scaling in pipework is not known. External monitoring of thick pipes does not give accurate information of potential specific activity of scale or thickness.
- Records of scale in pipe work that has been removed during maintenance programs are very inaccurate with regard to location of pipe work.

Problems

- Trans-frontier shipment of radioactive waste if structure sent to another country for demolition.
- If not shipped, does demolition yard in country of origin have licence/expertise in place to deal with radioactive materials.
- Steel must be decontaminated before being put on open market.
- Disposal of the NORM wastes. These can also have high mercury levels

Problems - FPSOs

- These are often a bigger problem because of the way in which they are operated.
- Nature of contracts means they are kept operational at all costs and as long as possible.
- When taken off contract very restrictive time constraints on period allowed for decommissioning and rebuild.
- Rebuild often not in country of oil production.

Problems - FPSOs

- Local work force no experience at all in working with NORM contaminated materials.
- Many countries require that local labour is used.
- No developed RPA or RPS training program in place.
- If local RPSs are available no experience of working in oil industry.
- External RPSs can not speak local language.
- Local safety culture not geared to working with radioactive materials where hazard can not be seen, heard or felt.

Suggested Solutions

- Decommissioning/rebuild should be planned from day 1 of operation to allow a comprehensive picture of potential NORM problem to be established.
- Where a non-experienced work force is to be used much planning/effort must be put in establishing good RPS cover using local RPSs.
- Engineers in charge of contracts on FPSOs should be told, before the work starts, in strong terms, that working with NORM will slow things down and that the radiation will not go away no matter how much they shout at it. Ideally this should be addressed at the tendering stage.