bp compact deaeration experience

from the North Sea and Gulf of Mexico

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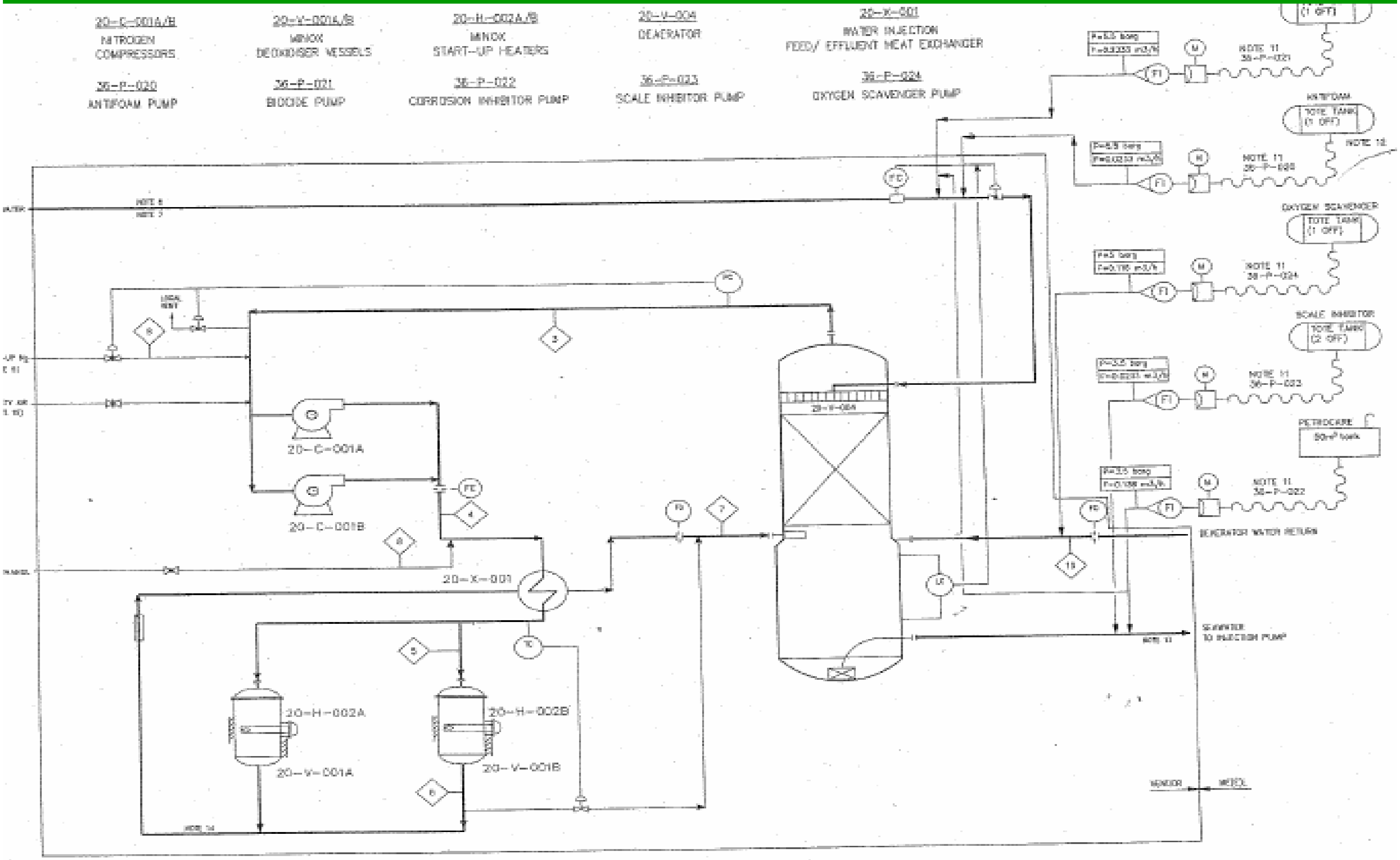
introduction

In late 2000, BP (with Mustang Engineering) did a study to select an offshore SW deaeration process for the upcoming DW Gulf of Mexico projects.

- The study converted all factors into cost: deck space, package weight and overall package life-cycle cost
- BP operated compact deaeration packages installed in the late 90s in the North Sea were successful, Foinaven operating with no supplemental oxygen scavenger
  - Note: The above units are single stage, using a catalyst reactor but no static mixer & separator. They have a stripping tower installed instead
- The overall cost comparison, size of the package and early North Sea performance led the study to select compact deaeration as the recommended technology

North Sea compact deaeration PFD

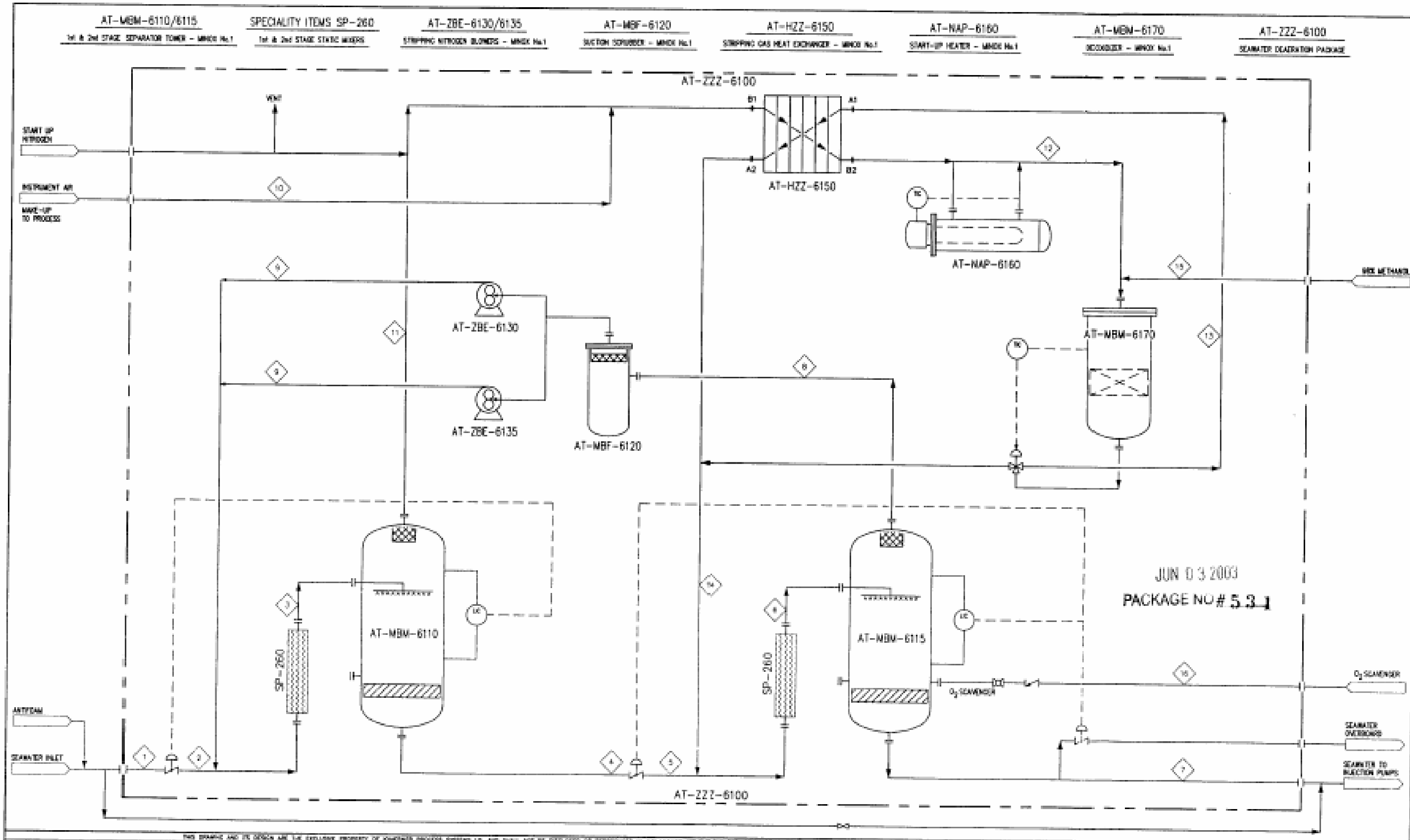


Bp compact deaeration installations

Current BP compact deaeration use:

North Sea	2 locations	(FPSOs)	Single stage	1999
North Sea	2 locations	(Platform)	Two stage	2003/06
GoM	1 location	(Spar)	Two stage	2006
GoM	2 locations	(Semi)	Two stage	----

typical compact deaeration package



bp GoM compact deaeration perspective:

- The compact deaeration technology used by BP in the Gulf of Mexico is undergoing continual development & refinement to address both design & operational issues. Compact deaeration is not yet a fully mature technology
- Primary issues are in the package instrumentation and controls as well as component metallurgy
- The compact deaeration designers have subsequently identified design deficiencies in the GoM type design; however the vendor has little operational experience with these units

recommended design changes

During review of the GoM deaeration packages, the following vendor design changes were recommended:

- Do not use ‘different’ static mixer sizes for turndown…the gas cannot be accurately proportioned between the two mixers and this severely limits capacity of the unit
- Separator inlet has been refined. The design vendor now recommends using a cyclone inlet if Δp allows, primarily to eliminate the use of antifoam. (They have also recommended an outlet cyclone demister for carryover)
- With the new inlet, the design vendor is revisiting blower discharge pressure and now considering a compressor. Blower discharge pressure often limits system capacity

recommended design changes (cont)

- Design requirements were not clear up front; GoM now retrofitting catalyst water wash and regeneration capability
- An accurate, reliable and robust oxygen monitor would be a positive addition to package instrumentation
- Current GoM units were built with little control or measurement of process inflows. The design vendor recommends adding shutdown valves to the nitrogen supply line. Further instruments & controls likely need to be considered.
- Must ensure IA to the package does not contain trace lubrication oil which can poison the catalyst
- Chemical inhibition programs are not developed. Need bio-fouling chemicals, scale inhibition (can be a significant issue), shock biocide, nitrates, etc. Location of injection point in relation to the catalyst also needs consideration.

metallurgy:

- Many BP issues on the GoM deaeration package relate to metallurgy. Either there are corrosion issues, stress chloride cracking or high temperature materials required.
- The North Sea has experienced 2 runaway temperature excursions, saturating the temperature probe at its 510° C set point. Temperatures were estimated at 600 to 700° C
- BP is exploring the use of an SIS instrumented system to limit the potential temperature excursion and avoid the need for exotic (high temperature) valves, vessels and pipe

designer proposed control system

The design vendor has recommended a new control system for the compact deaeration package:

- 1st stage separator pressure controlled by PCV on IA
- An O_2 analyser upstream of the deoxidiser overriding the 1st stage pressure control and manipulating methanol flow control
- 2nd stage pressure would be controlled by an actuated PCV on the vent line

further design modifications:

A major issue is the possible runaway thermal reaction in the deoxidizer.

Further design modifications are being considered based on the GoM design with their large start-up heaters

- Eliminate instrument air, use heater and nitrogen as process makeup. This will substantially reduce the risk of runaway thermal reactions in the catalyst bed.
- Install a secondary nitrogen quench system to control runaway temperatures

conclusions

With 7 units installed, BP has a significant commitment to ensuring the compact deaeration process works

There are several areas where this technology needs to be developed in tandem with operating experience

- Package metallurgy
- Safety (runaway temperature reaction)
- Process controls & instrumentation
- Chemical injection (locations, type of and performance)