



ESDU SPF-M4-2

Major effort on rig design

Unamended
Issued 01 Oct 2007
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Major effort on rig design

Sub-Project F Annulus Flow Tests
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25th September 2007

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TEST PARAMETERS

CRUDE OIL INLET TEMPERATURE - max. 300°C [200 - 270°C]

CRUDE OIL PRESSURE: max. 30 BAR

TEST SURFACE TEMPERATURE: 250 - 350°C [oil plus 120°C max.]

HEAT FLUX TO BE IMPARTED TO OIL: 20 – 100 kW/m²

FLUID HYDRODYNAMICS:

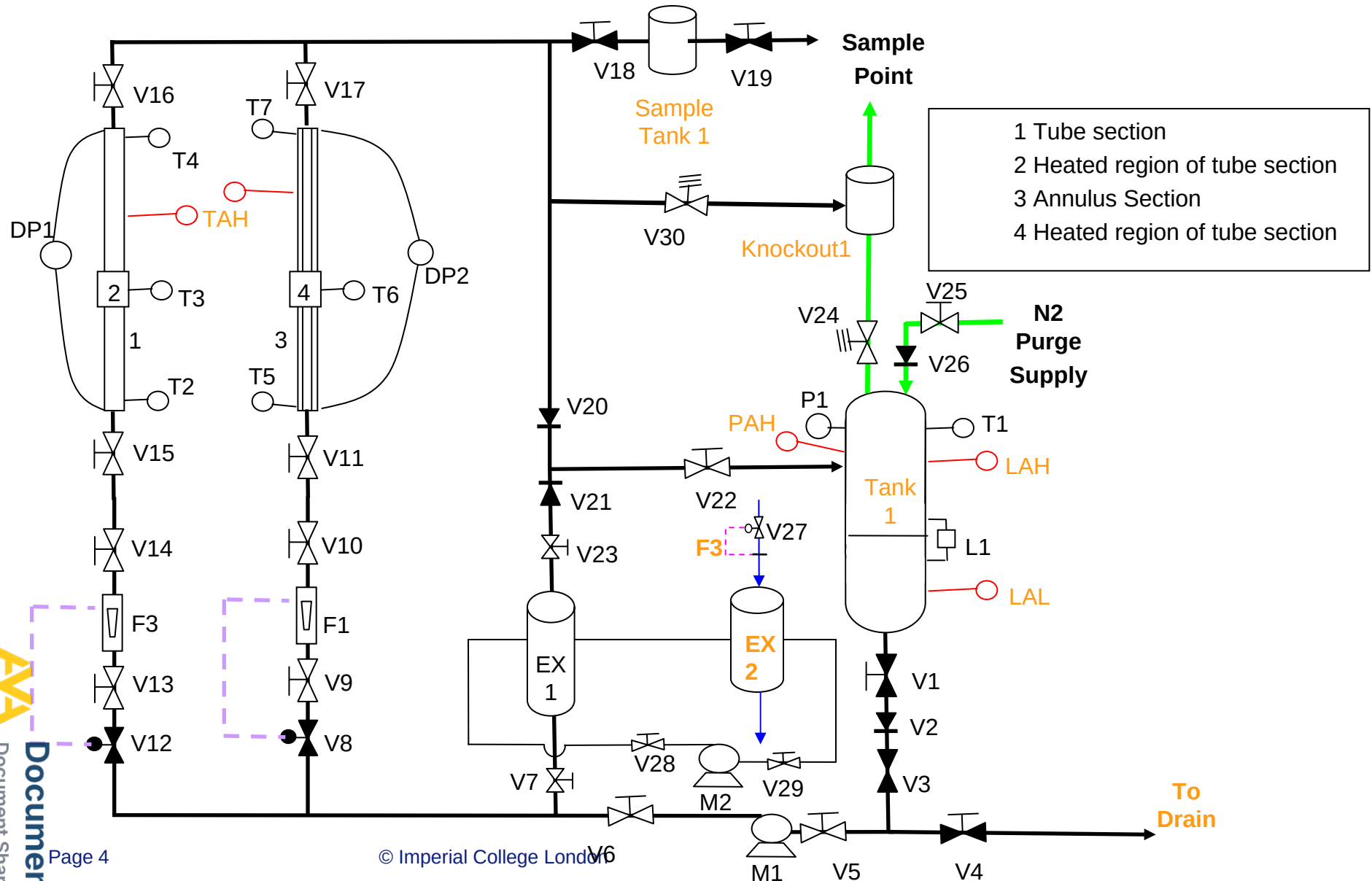
- LINEAR VELOCITY: 1 – 3 m/s
- REYNOLDS NUMBER: max. 20,000
- ANNULUS DIMENSIONS: 2 – 5 mm

TEST SECTION LENGTH: ~ 2 m heated plus entry section

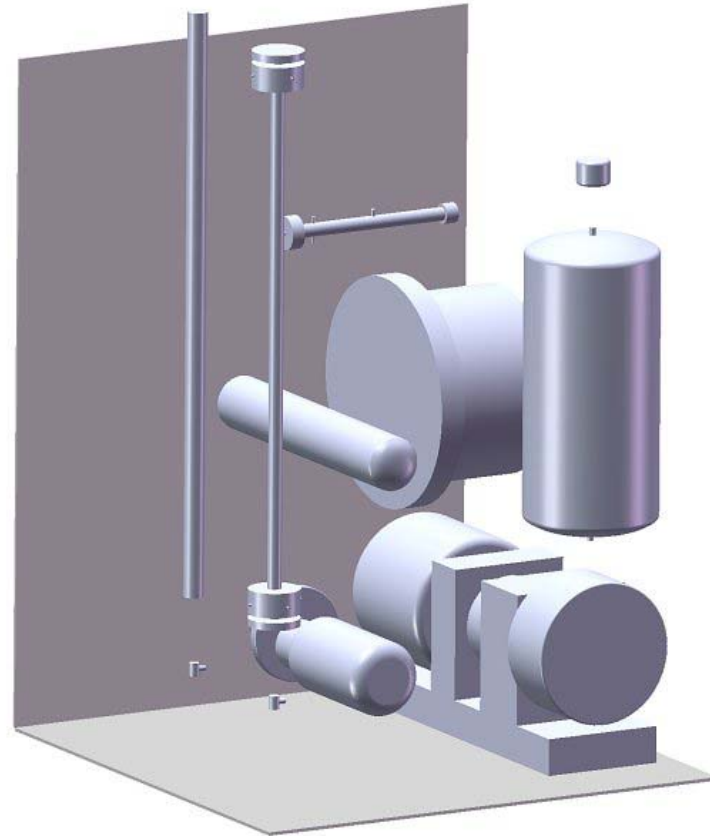
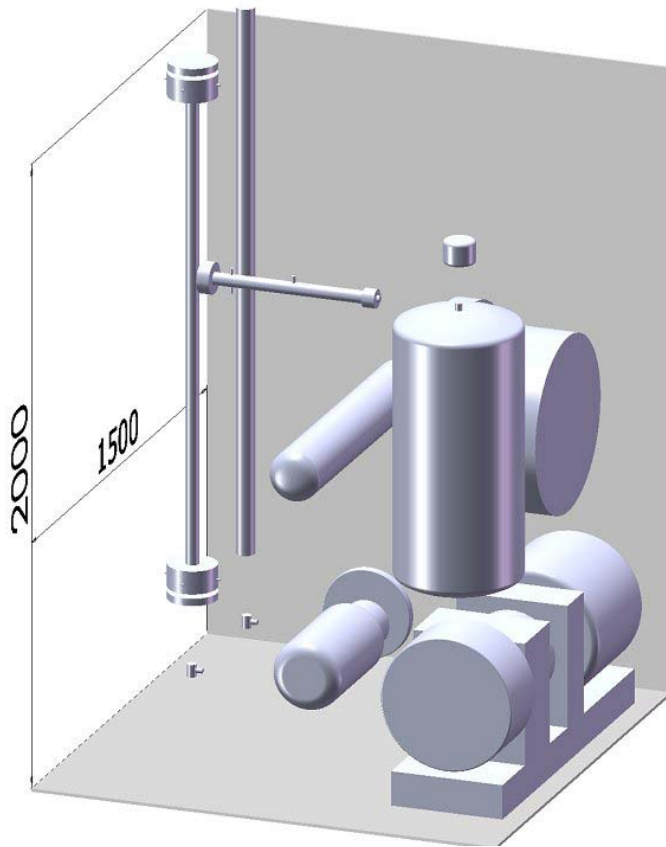
SURFACE PROPERTIES – TYPE OF STEEL, etc

CLEANING STRATEGIES, ADDITIVES, SURFACE MODIFICATION

FOULING MEASUREMENT TEST LOOP



FOULING MEASUREMENT TEST LOOP



RIG DESIGN ISSUES

- TEST SECTION
 - ANNULUS
 - TUBE
 - BOTH
- ORIENTATION
 - HORIZONTAL
 - VERTICAL
- TEST SECTION HEATING LOCATION
 - EXTERNAL SURFACE
 - INTERNAL SURFACE

RIG DESIGN ISSUES

- TEST SECTION HEATING TYPE
 - INDUCTION CARTRIDGE (ANNULUS)
 - INDUCTION RING (TUBE / ANNULUS)
 - **JOULE HEATING (TUBE / ANNULUS)**
- TEMPERATURE CHANGE DURING PASSAGE ALONG TEST-SECTION
 - 10⁰C to 15⁰C
- OIL STORAGE (DURING TEST)
 - AMBIENT
 - **HOT**

RIG DESIGN ISSUES

- TEST SECTION
 - FIXED
 - MOBILE
- POTENTIAL LOCATION
 - REFINERY ?
- RIG
 - TESTLINE + FEED LOOP + DATA LOGGERS
 - TESTLINE + DATA LOGGERS
- TESTLINE MATERIAL
 - STAINLESS STEEL
 - CARBON STEEL (FOULING CHARACTERISTICS)
- CONNECTIONS
 - SWAGELOK
 - WELDED