

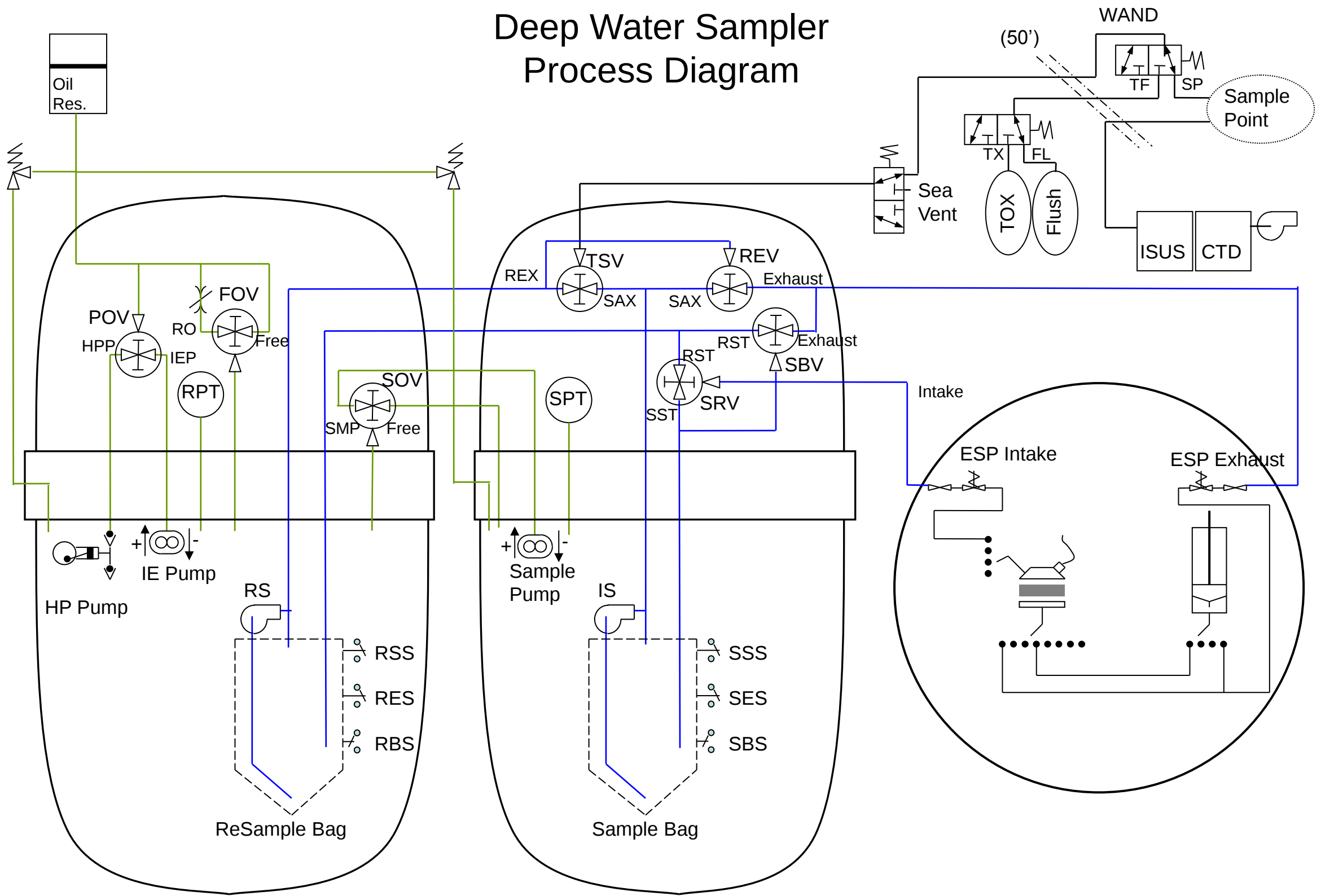
4km DWSM
Operation

Mechanical Systems

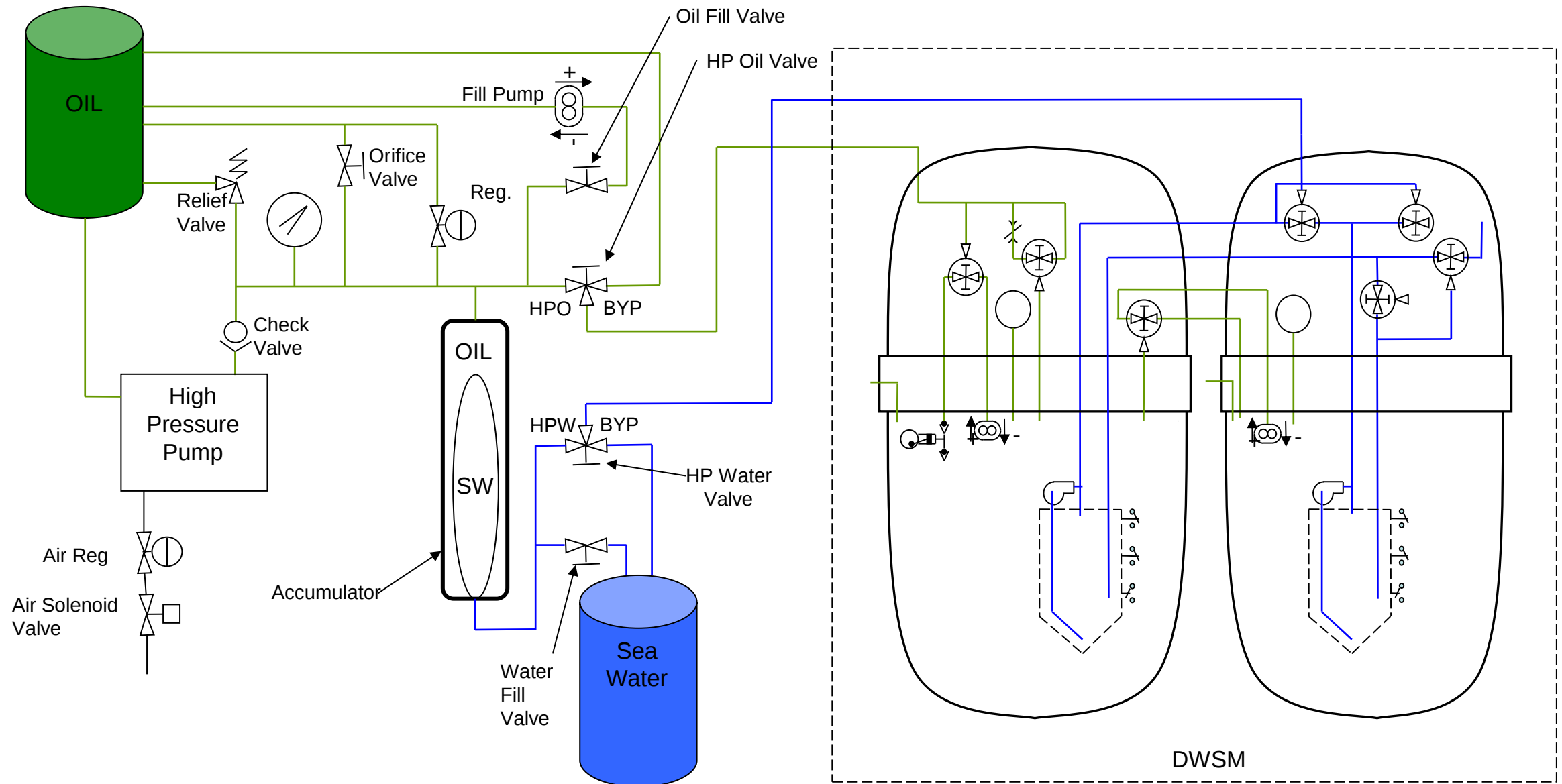
Simple Operating Theory

- Intake seawater
- Decompress
- Transfer and release gas
- Sample (thru core)
- Recompress
- Exhaust seawater
- Decon System

Deep Water Sampler Process Diagram



High Pressure Interface Process Diagram

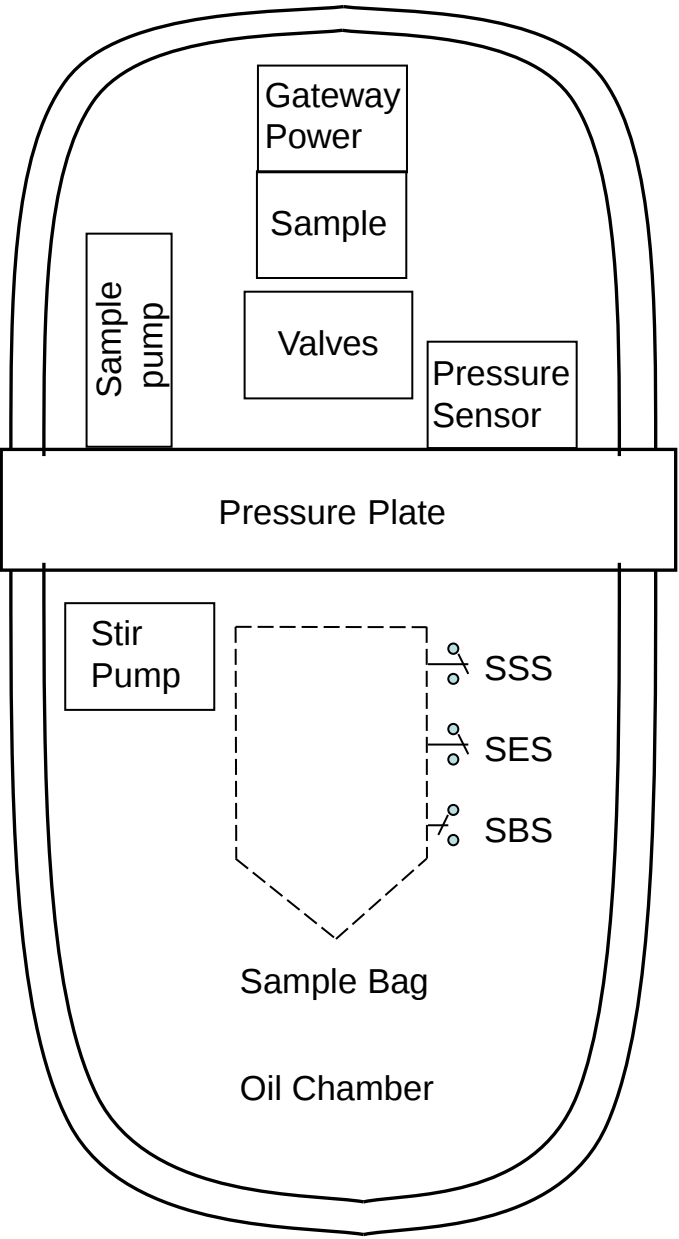
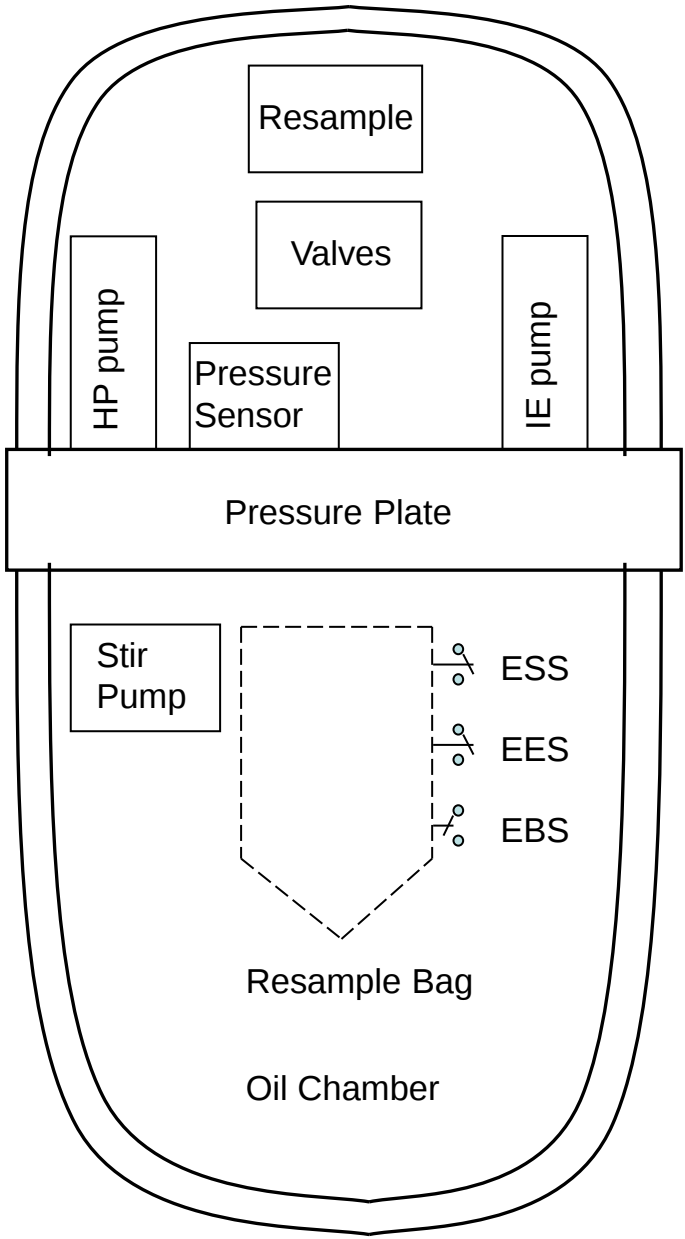


Mechanical Systems

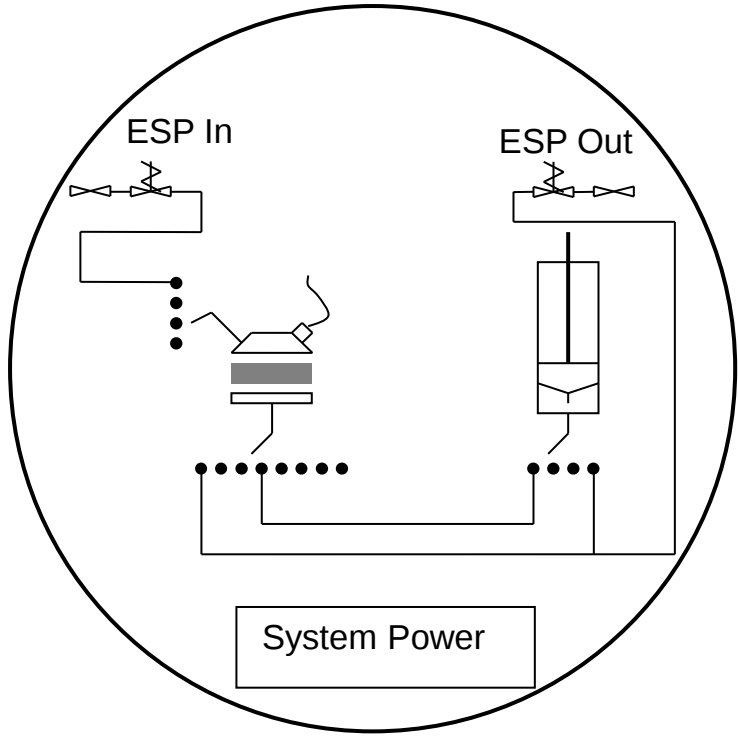
Simple Operating Theory

			Oil Valves			Water Valves								
	Valve Name		POV	FOV	SOV	TSV	REV	SRV	SBV	WMV	Wand Cap	HP Pump	IE Pump	Sample Pump
	Valve description		<i>Pump Oil Valve</i>	<i>Flood Oil valve</i>	<i>Sample Oil valve</i>	<i>Toxicant Sample valve</i>	<i>Resample Exhaust Valve</i>	<i>Sample resample valve</i>	<i>Sample Bypass Valve</i>	<i>Wand Manifold Valve(s)</i>				
			<i>Closed x2</i>	<i>Closed x2</i>	<i>Closed x2</i>	<i>Closed x2</i>	<i>Closed x2</i>	<i>Closed x2</i>	<i>Closed x2</i>	<i>Toxicant</i>	<i>closed</i>	<i>OUT</i>	<i>IN</i>	<i>FWD</i>
	Potential Valve positions/Names		<i>HP Pump HPP</i>	<i>Orifice OR</i>	<i>Sample Pump SMP</i>	<i>Resample top REX</i>	<i>ESP Exhaust Sample top SAX</i>	<i>Resample Tube RST</i>	<i>ESP Exhaust Resample Tube RST</i>	<i>Flush</i>	<i>open</i>	<i>off</i>	<i>OUT</i>	<i>RVS</i>
			<i>I/E pump IEP</i>	<i>Free</i>	<i>Free</i>	<i>Sample top SAX</i>		<i>Sample Tube SST</i>	<i>Wand Sea</i>				<i>off</i>	<i>off</i>
	State Description	Terminating Condition												
0	Wake up													
1	All bags/lines toxicated		Closed	Free	Free	Closed	Closed	Closed	Closed	Closed	Closed	off	off	off
2	Empty Bags	RES AND SES active	IEP	Closed	Free	REX	SAX	Closed	Closed	Sea	Closed	off	IN	off
3	Intake Flush Resample bag	Draw X flush volume	IEP	Closed	Free	REX	Closed	Closed	Closed	Flush	Closed	off	OUT	off
4	Intake Flush Sample bag	Draw XX flush volume	IEP	Closed	Free	SAX	Closed	Closed	Closed	Flush	Closed	off	OUT	off
5	Flush DWSM lines from Sample 1	SAM FWD x volume	IEP	Closed	SMP	Closed	SAX	Closed	Closed	x	Closed	off	off	FWD
6	Flush DWSM lines from Sample 2	SAM FWD x volume	IEP	Closed	SMP	Closed	Closed	Closed	RST	x	Closed	off	off	FWD
7	Flush Wand from Sample (alternate, with SMP)	push xx flush out wand	IEP	Closed	Free	SAX	Closed	Closed	Closed	Wand	Open	off	IN	off
				Free	SMP								off	FWD
8	Empty Bags (of Flush)	RES AND SES active	IEP	Closed	Free	REX	SAX	Closed	Closed	Sea	Closed	off	IN	off
9	Seawater rinse wand, get ISUS/CTD	xxx time	IEP	Closed	Free	SAX	Closed	Closed	Closed	Wand	Open	off	off	off
9	Intake Sample	Draw XX sample volume	IEP	Closed	Free	SAX	Closed	Closed	Closed	Wand	Open	off	OUT	off
10	Isolate sample		Closed	Free	Free	Closed	Closed	Closed	Closed	x	Closed	off	off	off
	Depressurization													
11	Depressurize	Look for bubble or pressure	HPP	Closed	Free	Closed	Closed	Closed	Closed	x	Closed	ON	off	off
	PASS GAS													
13	Flush core lines	ESP push x flush out intake	Closed	Closed	Closed	Closed	Closed	RST	Closed	x	Closed	off	off	off
14	Sample (Alternate, core syringe)	Push XX volume thru core	Closed	Closed	SMP	Closed	Exhaust	SST	Closed	x	Closed	off	off	FWD
		ESP syringe sample till done	Closed	Closed	Free	Closed	Exhaust	SST	Closed	x	Closed	off	off	off
15	Wait for core to purge	Core purges intake, exhaust	Closed	Closed	Free	Closed	Exhaust	SST	Closed	x	Closed	off	off	off
16	Isolate from Core		Closed	Closed	Free	Closed	Closed	Closed	Closed	x	Closed	off	off	off
17	High Delta P Repressurize	until pressure is close, wait	Closed	OR	Free	Closed	Closed	Closed	Closed	x	Closed	off	off	off
18	Low Delta P Repressurize		Closed	Free	Free	Closed	Closed	Closed	Closed	x	Closed	off	off	off
19	Empty sample Bag	SES active	IEP	Closed	Free	SAX	Closed	Closed	Closed	Sea	Closed	off	IN	off
20	Empty most of Resample Bag	push all but mix volume	IEP	Closed	Free	REX	Closed	Closed	Closed	Sea	Closed	off	IN	off
21	Intake toxicant mix into resample	Draw X TOX volume	IEP	Closed	Free	REX	Closed	Closed	Closed	TOX	Closed	off	OUT	off
22	Tox Wand from ReSample	push xx toxmix out wand	IEP	Closed	Free	REX	Closed	Closed	Closed	Wand	Open	off	IN	off
23	Tox DWSM lines 1	push xx toxmix into sample	Closed	Closed	SMP	Closed	SAX	Closed	Closed	x	Closed	off	off	RVS
24	Tox DWSM lines 2	push half toxmix into sample	Closed	Closed	SMP	Closed	Closed	Closed	RST	x	Closed	off	off	RVS
25	Run stir pumps	xx time	Closed	Free	Free	Closed	Closed	Closed	Closed	x	Closed	off	off	off
26	Shut down		Closed	Free	Free	REX	SAX	Closed	Closed	x	Closed	off	off	off

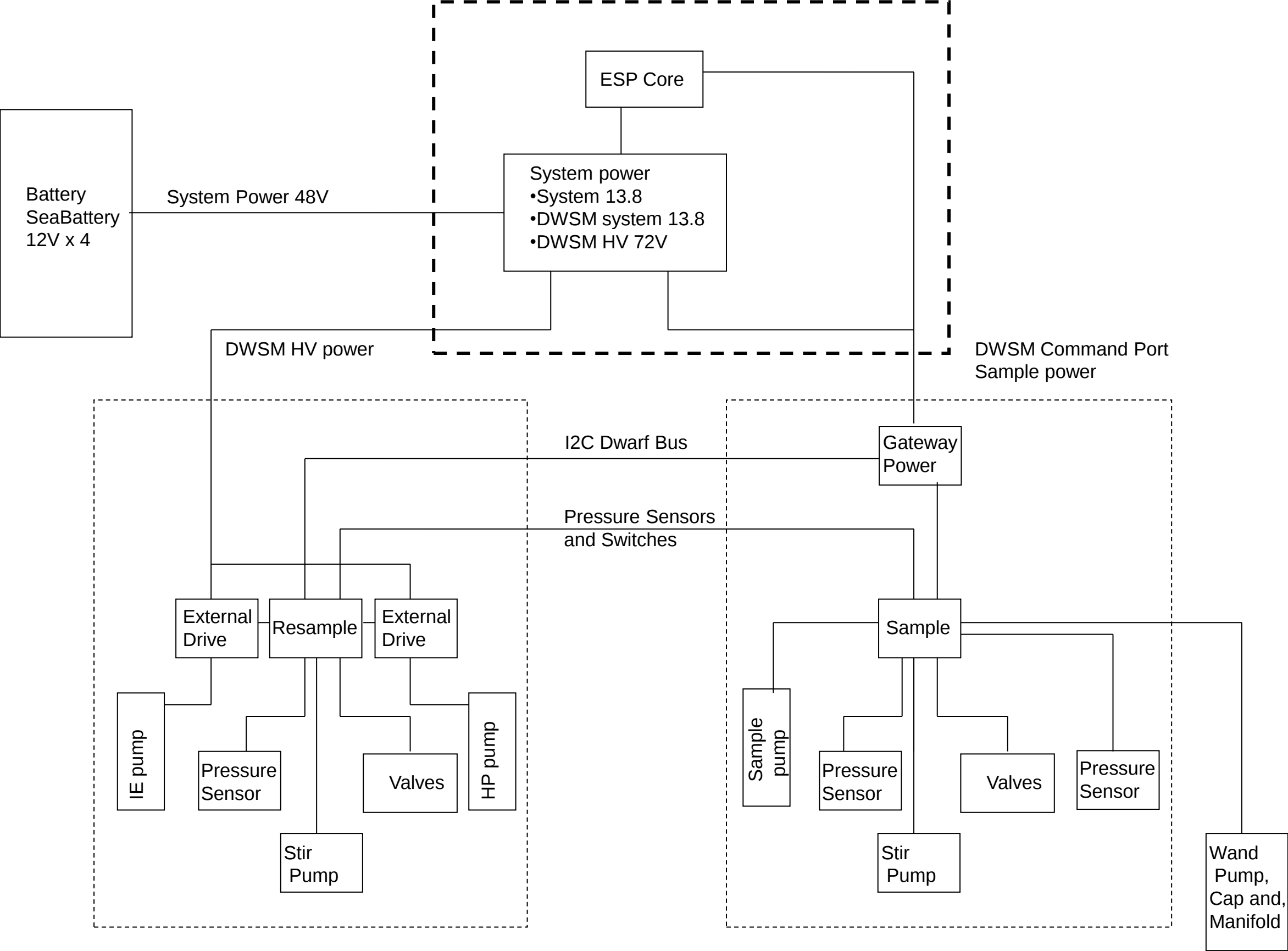
Deep Water Sampler Aqua Lung



Wand
Pump,
Cap and
Manifold



Battery



4Km Deep Water Sampler Initialization

- Power up to dive-safe state with no knowledge of history
- To open water bags and oil reservoir to sea:
 1. Isolate ESP core: SRV to Close, REV to Close, TSV to Close
 2. Equalize oil pressure between cans: Open SOV to Free
 3. Equalize water pressure between bags: Open REV to SAX (Exclude Exhaust)
 4. Gradually equalize oil with oil reservoir (sea): Open FOV to RO
 5. Finish equalizing oil with oil reservoir (sea): Open FOV to Free
 6. Equalize bags with sea: Open Wand to Sea, TSV to SAX
- Timeouts waiting for pressure to equalize imply:
 - Blockage, valve (actuator) failure, or leaks
 - Won't be very sensitive in practice because sensor offset varies
- Only after equalized can PSI sensors' relative offsets be computed
 - Their absolute offsets can be corrected by CTD if it's available
- Pressure relief valves between both cans and oil reservoir
 - Ensure that water is not expelled under pressure on deck
 - Avoids stretching bolts if DWSM raised while powered off

4Km Deep Water Sampler Pre-dive preparation

- Flush DWSM with clean water on deck
 - Same as flushing with Flush fluid, but wand opens to cap port
- Tare pressure sensors
 - Only a first approximation, as temperature will change at depth
- Leak checks
 - Pressurize oil to max safe pressure, verify stable
 - Probably not practical
- Dummy Sample run
 - Replace ESP core with filter tube