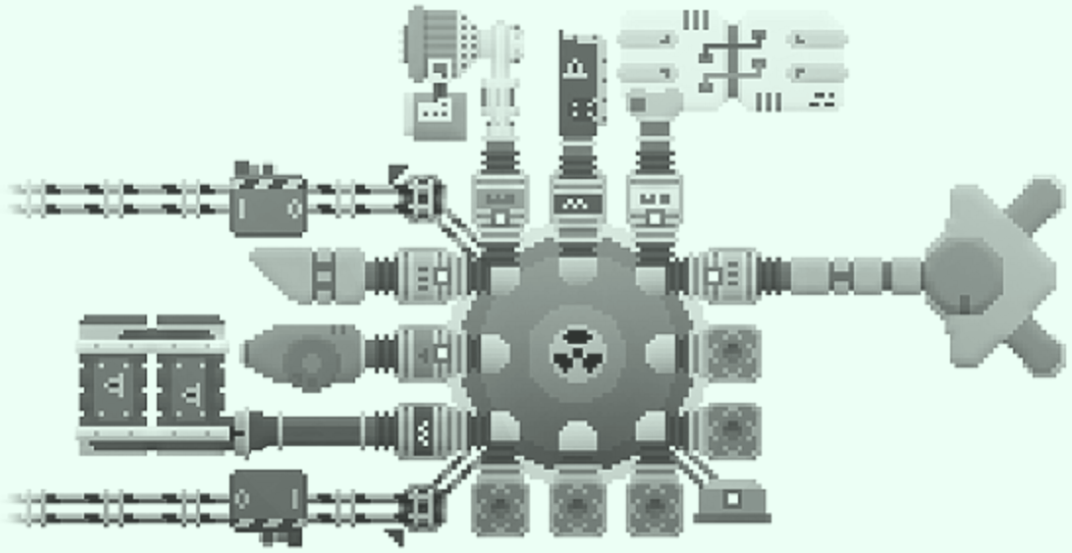
SULAIMAN “X[X] TW” INERTIAL CONFINEMENT FUSION REACTOR

APPROVED OPERATIONS MANUAL



V0.14.0.1

CONTENTS

REACTOR COLD-START SEQUENCE TO IGNITION AND IDLE BATTERY-CHARGING

Pre-Start Checklist

(Verify Fusion Field Coils Assembly undamaged)
(Verify X(X) TW™ Reactor Core undamaged)
(Verify Cryo Reservoir undamaged)
(Verify Cryo Distribution Pump undamaged and with minimal wear)
(Verify Fusion-Grade Laser Capacitor(s) undamaged)
(Verify Fusion Laser Array(s) undamage)

[NOTE: One [1] Fusion-Grade Laser Capacitor supplies power for two [2] Fusion Laser Arrays]

(Verify Reactor Fuel Regulator undamaged)
(Verify Pellet Feeder undamaged)

[NOTE: One [1] Reactor Fuel Regulator supplies fuel for two [2] Pellet Feeders]

(Verify Magnetohydrodynamic [MHD] Generator undamaged)
(Verify Fusion Core Pump undamaged)
(Verify ship battery charge sufficient to perform reactor cold-start)

Cold-Start Checklist

► Set PWR BUS position BATT
► Wait for lamp test to complete
(Verify all lamps indicate during lamp test)
[NOTE: If lamp test does not indicate, set PWR BUS position OFF and return to beginning of checklist]
(Verify BATT. % POWER showing green)
(Verify CAPACITOR CHARGE increasing or indicating READY)
[NOTE: If CAPACITOR CHARGE lamps do not indicate, set PWR BUS position OFF and return to beginning of checklist]
(Verify FUEL He3 [Helium 3] kg level displays [> 6.6 kg minimum recommended])
(Verify FUEL D [Deuterium] kg level displays [> 4.45 kg minimum recommended])
(Verify CORE PRESSURE indicating VAC)
If ROUGH:
► Set CORE PURGE position RHG
(Verify CORE PRESSURE decreasing)
► Wait for CORE PRESSURE to indicate VAC
► Set CORE PURGE position OFF
[NOTE: If Core Pump not present, CORE PURGE will not function]
If no Core Pump:
► Set CYCLE position OPEN [Vacuum Only]
(Verify CORE PRESSURE decreasing)
► Wait for CORE PRESSURE to indicate VAC
► set CYCLE position CLOSED
[NOTE: No CORE PRESSURE lamp indicates for VAC on new and long-dormant SULAIMAN X[X]TW ICF Reactors
COMMON FAULT: For certain build numbers, no CORE PRESSURE lamp indicates for VAC if vacuum perfect or near-perfect - assume indication failure to be a VAC indication]
(Verify LAS ALIGN lamp indicates solid white)
► Set LAS ALIGN position 1 [ON]
(Verify LAS ALIGN READY lamp indicates solid green)
(Verify PEL FEED lamp indicates solid white)
► Set PEL FEED position 1 [ON]
(Verify PEL FEED READY lamp indicates solid green)

► Set CRYO position 1 [ON]
[NOTE: If Cryo Pump not present, CRYO switch will remain inoperable]

(Verify THRUST ACTIVE Safety in position OFF)
(Verify FLOW in position MINIMUM)
(Verify CYCLE in position CLOSED)

► Press button FUEL REG on FIELD COILS
(Verify button FUEL REG lamp indicates solid on)
[⚠ CAUTION: FIELD COILS REQUIRE HIGH BATTERY LOAD. PROCEED WITH HASTE ⚠]
► Press button FWD on FIELD COILS
(Verify FWD lamp indicates solid on)
► Press button REAR on FIELD COILS
(Verify REAR lamp indicates solid on)
(Verify RATIO in position MHD)
► Set MHD position 1 [ON]
[NOTE: If no MHD present, reactor will NOT output power to charge batteries]

(Verify CORE PURGE in position OFF)
(Verify CAPACITOR CHARGE indicates READY)

(Verify CYCLE in position CLOSED)
(Verify CYCLE in position CLOSED)
(Verify CYCLE in position CLOSED)

(Verify Field Coils FWD lamp indicates solid on)
(Verify Field Coils FWD lamp indicates solid on)
(Verify Field Coils FWD lamp indicates solid on)

(Verify Field Coils REAR lamp indicates solid on)
(Verify Field Coils REAR lamp indicates solid on)
(Verify Field Coils REAR lamp indicates solid on)

(Verify READY lamp indicates solid green)

⚠ ⚠ ⚠ ⚠ ⚠

DO NOT INITIATE REACTOR WITHOUT FIELD COILS ACTIVE
DO NOT INITIATE REACTOR WITHOUT FIELD COILS ACTIVE
DO NOT INITIATE REACTOR WITHOUT FIELD COILS ACTIVE

► Set IGNITION position 1 [ON]

DO NOT INITIATE REACTOR WITHOUT FIELD COILS ACTIVE
DO NOT INITIATE REACTOR WITHOUT FIELD COILS ACTIVE
DO NOT INITIATE REACTOR WITHOUT FIELD COILS ACTIVE

⚠ ⚠ ⚠ ⚠ ⚠

(Verify X-RAY WARN lamp remains off)
[⚠ CAUTION: If X-RAY WARN lamp indicates or X-RAY WARN alarm sounds, SHUT-DOWN IMMEDIATELY ⚠]
(Verify ABL WALL WARN lamp remains off)
(Verify CORE PRESSURE indicates and holds above ROUGH in amber)
(Verify CORE TEMP indicates and holds amber or green)
(Verify FUEL kg/day display holds < 50 kg/day of fluctuation)
(Verify POWER THR indicates green)
(Verify POWER FUS indicates green)
(Verify POWER TOTAL indicates green)
(Verify POWER LOAD indicates green)
[NOTE: No lamp indication will occur if near minimum values]
FOR BATTERY CHARGE:
► Set MHD to position 1 [on]
► Set PWR BUS position CHRG
(Verify POWER MHD indicates green)
(Verify all connected batteries charging).
FOR THRUST:
► Set THRUST ACTIVE SAFETY to position 1 [on]

Reactor Shut-Down Checklist

[NOTE: For safe Shut-Down, disable Reactor Fuel Regulator, disable ignition or switch power bus to off]

► Press FUEL REG button || set IGNITION position 0 [off] || set PWR BUS position OFF

(Verify FUEL REG button lamp off)

(Verify Reactor Shut-down)

(Verify no indication on all lamps)

(Verify PWR BUS position OFF) - CONT:

Reactor Shut-Down Safing Checklist

► Set PWR BUS position BATT

► Wait for lamp test to complete

(Verify all lamps indicate during lamp test)

[NOTE: If lamp test does not indicate, set PWR BUS position OFF and restart Shut-Down Safing checklist]

► Set CRYO position 1 [ON]

(Verify CORE TEMP decreasing)

► Wait until CORE TEMP decreases to 0 MeV

► Set CRYO position 0 [OFF]

► Set CORE PURGE position RGH

(Verify CORE PRESSURE decreasing)

► Wait until CORE PRESSURE lamp indicates VAC only

► Set CORE PURGE position OFF

► Set PWR BUS position OFF

[NOTE: Reactor Shut-down now complete]

Standard Reactor Components

Core System

1 ICFR Core

2 Fusion Field Coils Assembly

3 Fusion Core Pump

Ignition System

4 Fusion-Grade Laser Capacitor

5 Fusion Laser Assembly

Fuel System

6 Reactor Fuel Regulator

7 Pellet Feeder Assembly

8 D2o Canister

9 Liq He3 Canister

Cooling System

10 Cryo Distribution Pump

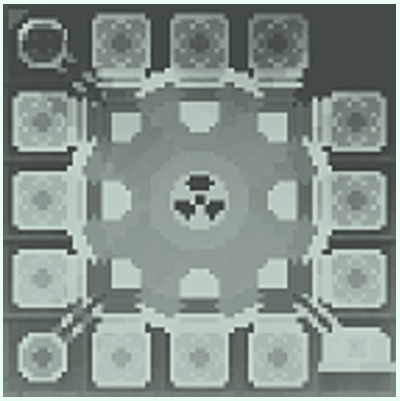
11 Cryo Reservoir

Power Systems

12 Magnetohydrodynamic (Mhd) Generator

13 Ship Battery

Core System

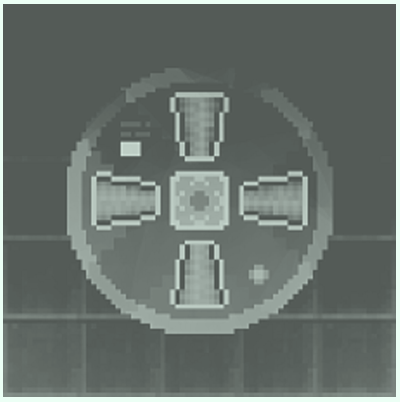


Sulaiman “X[X] TW” Inertial Confinement Fusion Reactor Core

The ICFR Core features the control system, containment chamber, Ablator Wall and Main Drive of the IC Fusion Reactor unit.

Installation Guide:
The ICFR Core is constructed directly around the fusion field coils assembly. Ensure the core is correctly centred over the coil assembly when installing.

Reactor electricity intake connection shown by inward facing red arrow (seen at bottom left of reactor in image provided)
Reactor output connection shown by outward facing red arrow
(seen at top left of Ship Batteries in image provided)



Fusion Field Coils Assembly

The Fusion Field Coils Assembly is an integral part of the reactor core providing protection from damage

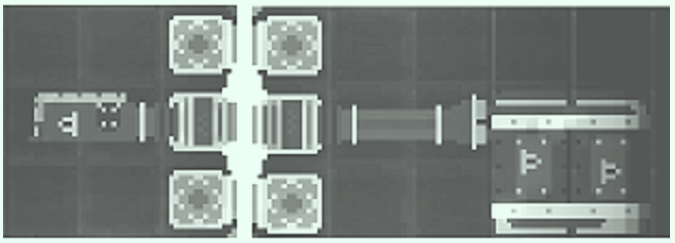
Installation guide:
The fusion field coils assembly sits directly within the Sulaiman X[X]TW ICFR Core providing necessary containment for core-plasma. It requires a complete ring of two [2] floor frame tiles to provide support for installation, and direct access to vacuum with one [1] floor tile removed in the centre of the support ring.

Fusion Core Pump

The Fusion Core Pump allows direct evacuation of plasma or remnant gases directly from the reactor core without imparting thrust to the vessel.

Installation guide:
The Fusion Core Pump allows connection to any of twelve [12] feed ports around the reactor core’s periphery.

Ignition System

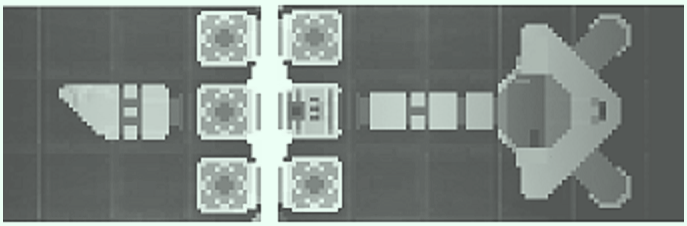


Fusion Laser Assembly (LEFT)
Fusion-Grade Laser Capacitor (RIGHT)
The ignition system targets fusion pellets with a high powered laser to initiate fusion once the pellets reach the centre of the core chamber.

Installation guide:
Both the Fusion Laser Assembly and Fusion-Grade Laser Capacitor allow connection to any of the twelve [12] core feed ports around the reactor core’s periphery.

One [1] Fusion-Grade Laser Capacitor is capable of supplying adequate power to two [2] Fusion Laser Assemblies.

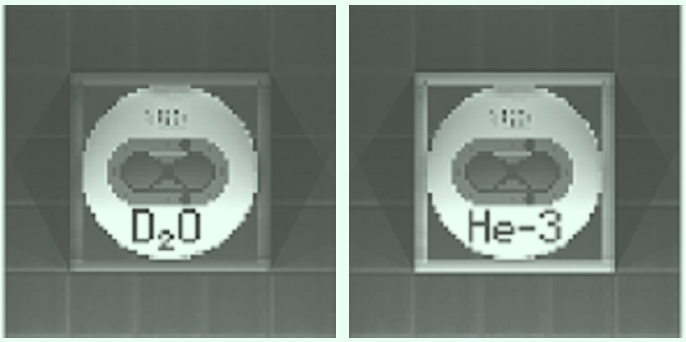
Fuel System



Pellet Feeder Assembly (LEFT)
Reactor Fuel Regulator (RIGHT)
The fuel system provides fuel for the reactor in the form of pre-mixed condensed charged pellets. The regulator is tasked with pre-forming each pellet, while the pellet feeder rapidly injects a stream of pellets directly into the core at high speed.

Installation guide:
Both the Pellet Feeder Assembly and Reactor Fuel Regulator allow connection to any of the twelve [12] core feed ports around the reactor core's periphery.

One [1] Reactor Fuel Regulator is capable of supplying adequate pellets to two [2] Pellet Feeder Assemblies.



D2O Canister (LEFT)
HE3 Canister (RIGHT)
Reactor Fuel Canister heads for integrated below-floor tanks containing Deuterium (D2O) and Helium 3 (He-3) store fuel required for ICFR operation.

Installation guide:
Reactor Fuel Canisters require a complete ring of two [2] floor frame tiles in addition to their standard footprint.

When placing two Reactor Fuel Canisters in close proximity, a minimum distance of four [4] frame tiles is required to allow adequate space for the wider sections of these canisters and plumbing below decks.

[NOTE: Due to the nature of a Deuterium, Helium-3 fusion reaction, a correctly operating reactor will use D2O and HE3 in a ratio of ~1 to 5.]

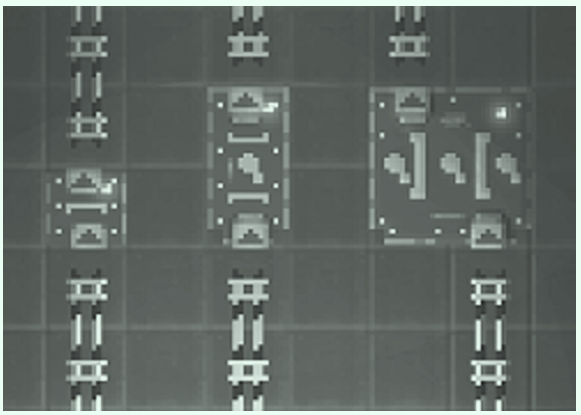
Cooling System

Cryo Reservoir (LEFT)
Cryo Distribution Pump (RIGHT)
The Cryo Distribution Pump and its associated Cryo Reservoir canister are essential for the automatic regulation of reactor core temperature.

Installation guide:
Cryo Reservoir canister requires a complete ring of two [2] floor frame tiles in addition to its standard footprint.

Cryo Distribution Pump allows connection to any of twelve [12] feed ports around the reactor core's periphery.

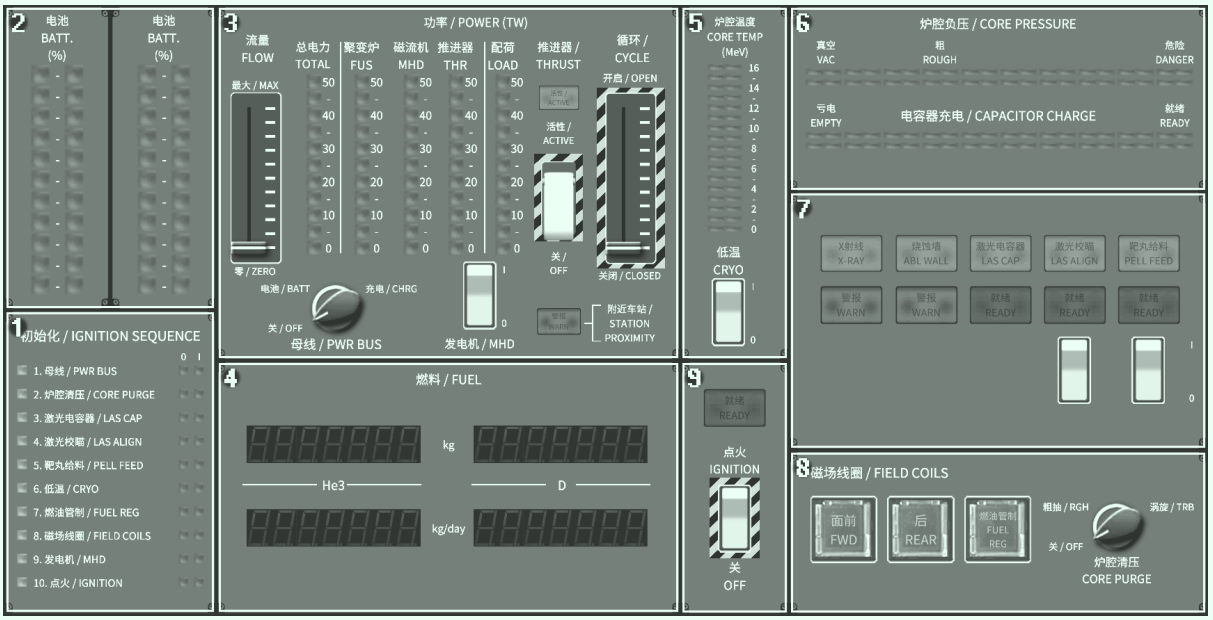
Power System



SHIP BATTERY(LEFT)
1: Mini XS
2: Compact S
3: Standard
MHD (MAGNETOHYDRODYNAMIC) GENERATOR (RIGHT)
Batteries are essential for providing charge to reactor components during start-up.
A small amount of Plasma is diverted through the Magnetohydrodynamic Generator in order to generate electricity to restore Ship Battery charge.

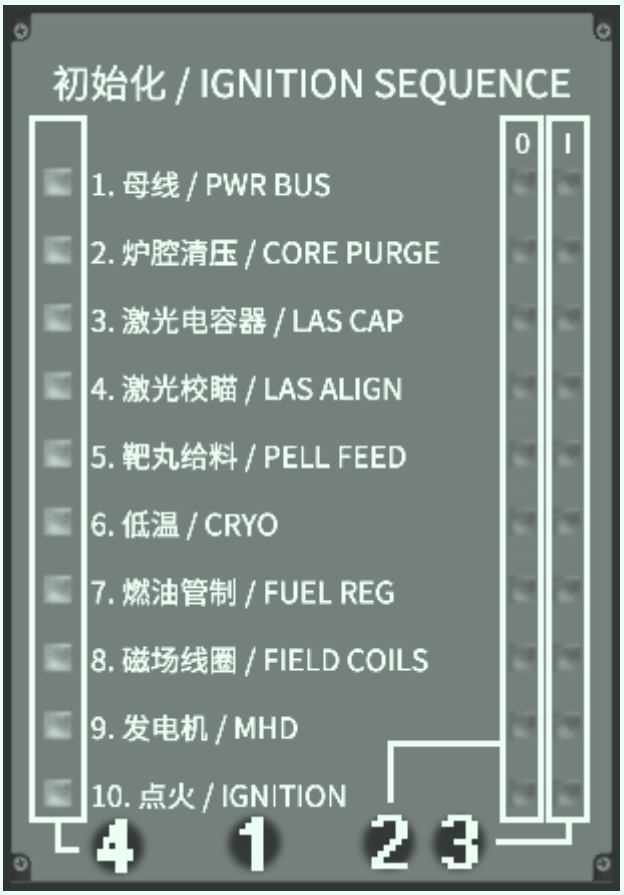
Installation Guide:
Battery charging connections shown by inward facing red arrow (seen at bottom of Ship Batteries in image provided)
Battery output connections shown by outward facing red arrow (seen at top of Ship Batteries in image provided)

Reactor Control Panel



(1) IGNITION SEQUENCE READY STATES
(2) BATTERY CHARGE LEVELS
(3) REACTOR SETTINGS AND OUTPUT
(4) FUEL GAUGES
(5) INTERNAL CORE TEMPERATURE AND COOLING
(6) INTERNAL CORE PRESSURE AND CAPACITOR CHARGE
(7) CENTRALISED READY AND CAUTION PANEL
(8) CORE CONTAINMENT, ENTRY AND EXTRACTION
(9) CORE IGNITION

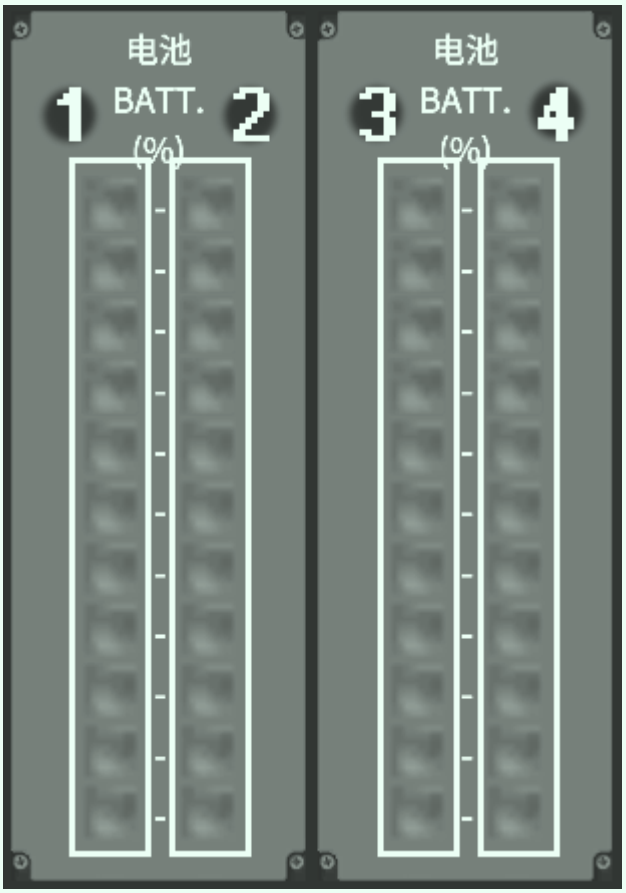
Reactor Control Panel PART 1
IGNITION SEQUENCE



1 IGNITION SEQUENCE INDICATOR LIST
   1) PWR BUS
   2) CORE PURGE
   3) LAS CAP
   4) LAS ALIGN
   5) PELL FEED
   6) CRYO
   7) FUEL REG
   8) FIELD COILS
   9) MHD
   10)IGNITION

2 NOT READY indicator lamps
3 READY indicator lamps
4 EQUIPMENT INOPERABLE/MISSING indicator lamps

Reactor Control Panel PART 2
BATTERY CHARGE LEVELS

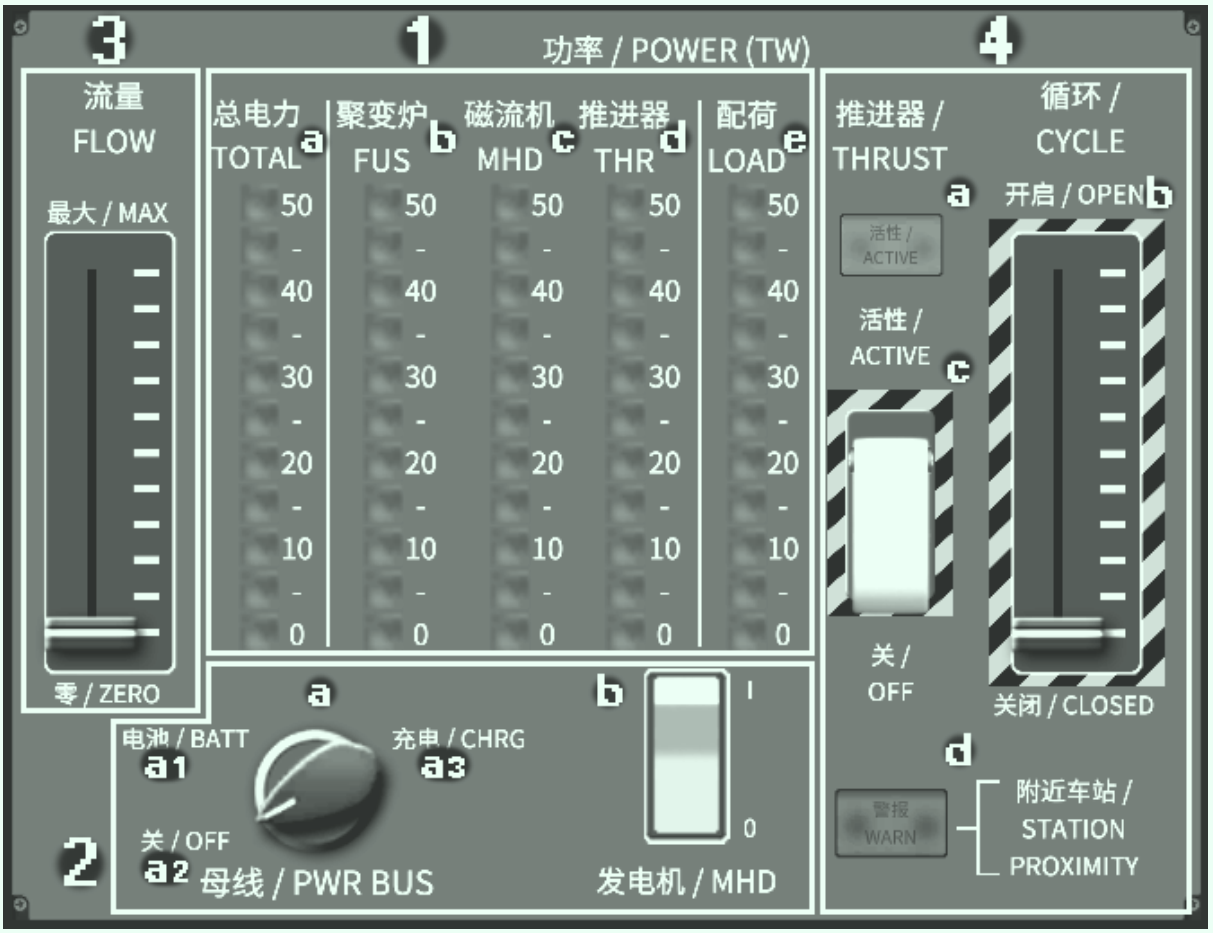


BATTERY CHARGE INDICATORS 1-4

[NOTE: Battery Charge % shows four [4] connected ship battery units maximum. More batteries can be connected to the reactor core via EMT Conduits, but will not display in indicator panels.]

1 CONNECTED BATTERY 1 CHARGE %
2 CONNECTED BATTERY 2 CHARGE %
3 CONNECTED BATTERY 3 CHARGE %
4 CONNECTED BATTERY 4 CHARGE %

Reactor Control Panel PART 3
REACTOR SETTINGS AND OUTPUT



1 POWER INDICATORS
- a) TOTAL
- b) FUS (Fusion generation)
- c) MHD (Magnetohydrodynamic generator output)
- d) THR (Total thrust output)
- e) LOAD (Total system load)

2 POWER SETTINGS
- a) PWR BUS (Power bus)
  - a1: BATT (Umbilical battery power mode) Reactor draws power from connected ship batteries. Start-up operation
  - a2: OFF (Mode Execute Ready/Access Standby) All power to reactor disabled
  - a3: CHRG (Active charging state) Normal operation. Allows MHD power to feed into ship batteries
- b) MHD (Magnetohydrodynamic Generator plasma feed toggle) Activates MHD and Allows battery charging if reactor cycling and PWR BUS set to position CHRG)

3 REACTOR FLOW THROTTLE (Adjusts fuel delivery rate into reactor core) Will generate additional heat and power

4 REACTOR THRUST SETTINGS

a) THRUST Indicator (ACTIVE) Indicates when reactor is set for open-cycle operations and may generate thrust)

b) REACTOR CYCLE THROTTLE (Adjusts reactor core aperture allowing direct plasma exhaust)

[⚠ CAUTION: DIRECT MANIPULATION OF REACTOR THRUST CONTROLS BYPASSES G-SAFE LOCKOUTS! EXTREME G FORCES MAY RESULT! ⚠]

c) THRUST ALLOW Switch and Safety Cover (Setting to ACTIVE enables reactor core exhaust)

d) STATION PROXIMITY WARN (Warning indicator lamp indicates if vessel within local NO-WAKE ZONE. Depart NO-WAKE ZONE under RCS power before enabling reactor thrust

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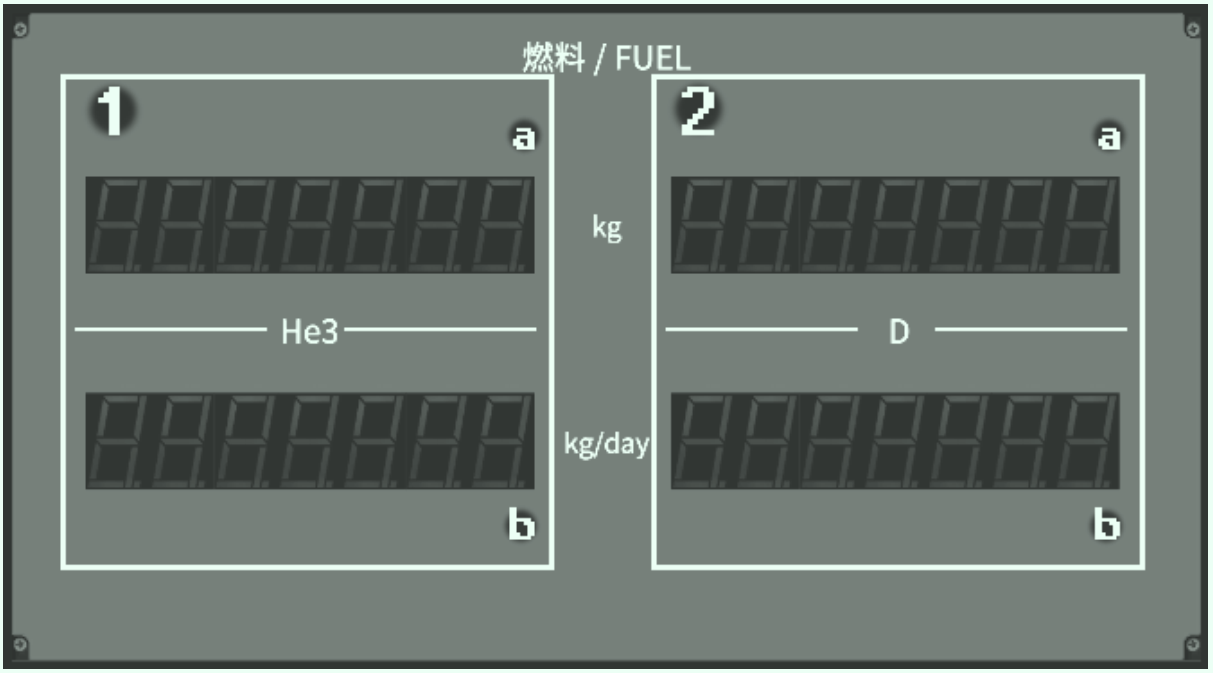
Reactor Control Panel PART 4

FUEL GAUGES



REACTOR FUEL CANISTER RESERVES

1 HE3 (Helium 3) Reactor Fuel HMD Readouts

a) Displays total reserve of He3 [He-3](HELIUM 3) in kilograms

b) Displays usage rate of He3 [He-3](HELIUM 3) kg/day (total kg usage per day) for current condition of reactor

2 D [D2O] (DEUTERIUM) Reactor Fuel HMD Readouts

a) Displays total reserve of D [D2O](DEUTERIUM) in kilograms

b) Displays usage rate of D [D2O](DEUTERIUM) in kg/day (total kg usage per day) for current condition of reactor

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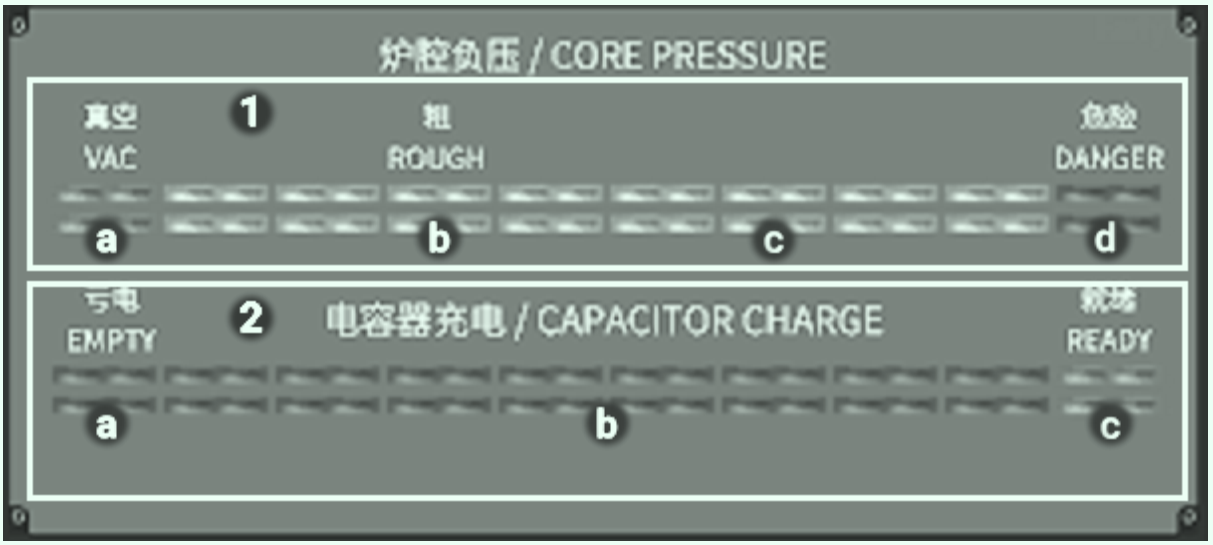
Reactor Control Panel PART 5
INTERNAL CORE TEMPERATURE AND COOLING

1 CORE TEMP (Internal core temperature display)
[NOTE: Do not operate reactor if CORE TEMP exceeds 14 MeV.]
[NOTE: Reactor performance will suffer if CORE TEMP under 10 MeV.]
2 CRYO (Cryogenic coolant pump control)
[NOTE: CRYO switch will not function without Cryo Distribution Pump.]

Reactor Control Panel PART 6
INTERNAL CORE PRESSURE AND CAPACITOR CHARGE



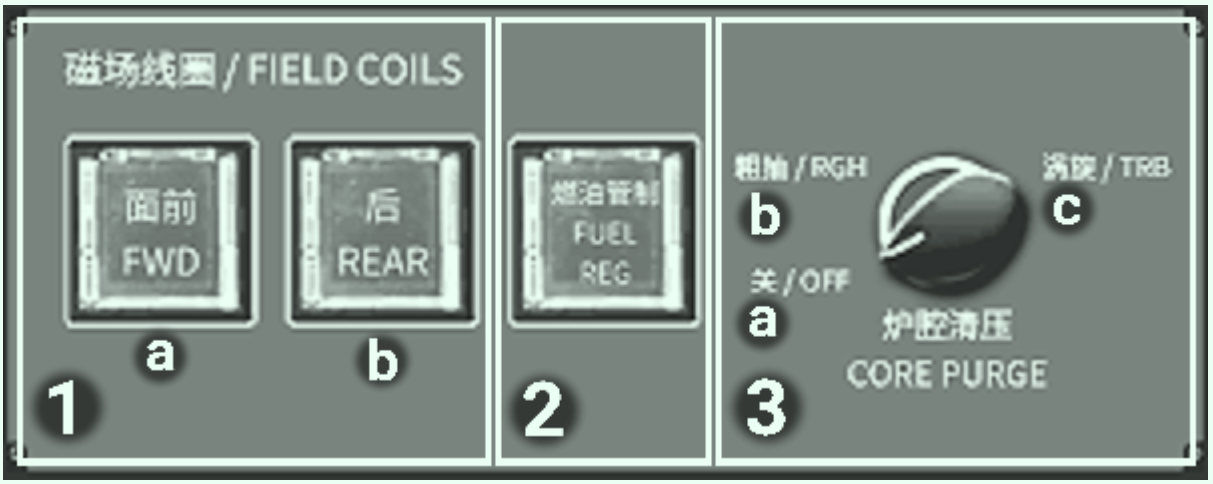
1 Core Pressure Display
a) VAC (Vacuum)
b) ROUGH (Suboptimal fusion due to low pressure)
c) GOOD (UNMARKED Standard pressure range for optimal fusion)
D) DANGER (High pressure - High risk of damage to ABL WALL and containment breach -)

Reactor Control Panel PART 7
CENTRALISED READY AND CAUTION PANEL

1 X-Ray Detection
a) X-Ray Detector Function Lamp

b) X-Ray Detection Warning Lamp
2 ABL WALL (Protective Ablative Wall)
a) ABL WALL
b) ABL WALL Warning Lamp
[NOTE: If ABL WARN lamp indicates
Flashing: ABL WALL at 50%
- Service at next opportunity
Solid:ABL WALL at total or near total ablation
- ⚠ SHUT-DOWN IMMEDIATELY ⚠
DO NOT USE
3 LAS CAP (Laser Capacitor)
a) XRAY Detector
b) XRAY WARN Warning Lamp
4 LAS ALIGN (Laser Array Alignment)
a) Laser Array correctly aligned
b) Capacitor fully charged
5 PELL FEED (Pellet Feeder)
a
b
c

Reactor Control Panel PART 8
CORE CONTAINMENT, ENTRY AND EXTRACTION



1 FIELD COIL CONTROL
The Fusion Field Coils Assembly is an integral part of the reactor system and provides protection for the vessel by use of the electromagnetic fields they generate

a) FWD
Engages forward field coil assembly

b) REAR
Engages rear field coil assembly

[NOTE: DO NOT OPERATE REACTOR WITHOUT CONTAINMENT]

2 REACTOR FUEL REGULATOR CONTROL
The FUEL REG (Reactor Fuel Regulator) button allows the placement of the Reactor Fuel Regulator into a powered or unpowered state. The Reactor Fuel Regulator is required for PELL FEED to function. Setting FUEL REG position OFF will safely shut-down reactor.

3 CORE PURGE
The CORE PURGE dial has three position settings for controlling the reactor's Fusion Core Pump [IF INSTALLED]
a) Off
Setting the CORE PURGE dial to position OFF places the Fusion Core Pump in an unpowered state. The Fusion Core Pump will not vent the Reactor Core while in this state.
b) RGH (Regular)
Setting the CORE PURGE dial to position RGH places the Fusion Core Pump in a powered state. The Fusion Core Pump will begin to safely vent the Reactor Core while in this state.
c) TRB (Turbo)
Setting the CORE PURGE dial to position TRB places the Fusion Core Pump in a powered state and at a high-volume 'turbo' speed. The Fusion Core Pump will begin to vent the reactor core quickly while in this state.
[NOTE: The Fusion Core Pump is not able to vent the Reactor Core while fusion underway.]

Reactor Control Panel PART 9
CORE IGNITION

1 REACTOR READY INDICATOR LAMP
Fusion reaction ignition is primed when lamp indicates READY
2 REACTOR IGNITION SWITCH
Reactor will START on setting IGNITION switch to IGNITION position
Ignition WILL NOT fire if POWER BUS set to OFF position
Ignition WILL NOT fire if CAPACITOR not READY
Ignition WILL NOT fire if CORE PRESSURE not VAC
Ignition WILL NOT fire if LASER ALIGNMENT not complete
Ignition WILL NOT fire if FUEL REGULATOR not active
Ignition WILL NOT fire if PELLET FEED not active

[⚠ CAUTION: Ignition WILL FIRE without CRYO COOLING and FIELD CONTAINMENT for low-power emergency start.
ACTIVATE FIELD COILS AND CRYO COOLING IMMEDIATELY AFTER EMERGENCY LOW-POWER REACTOR START - STARTING THE REACTOR WITHOUT FIELD CONTAINMENT OR COOLING VOIDS SULAIMAN X[X]TW INTERNAL CONFINEMENT FUSION REACTOR WARRANTY ⚠]

ADDITIONAL

Thank you for the purchase of this document.

The ADDITIONAL section, including NOTES, ADVICE, ADVANCED MAINTENANCE and ADVANCED OPERATIONS is unavailable with this documentation version.

Please purchase the EXTENDED EDITION manual for further reading.