



**C E G E L E C**

**Discoverer Enterprise**

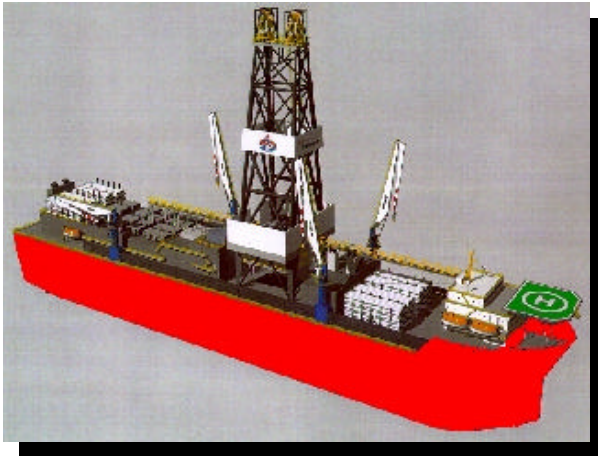
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**Discoverer Enterprise  
Dynamic Positioning Conference  
October 13-14, 1998**



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## Discoverer Enterprise



### Ship characteristics

Length, oa	254.4 m
Length, bp	240.0 m
Breadth	38 m
Depth	19 m
Service speed	14 knots
No.of passengers	200

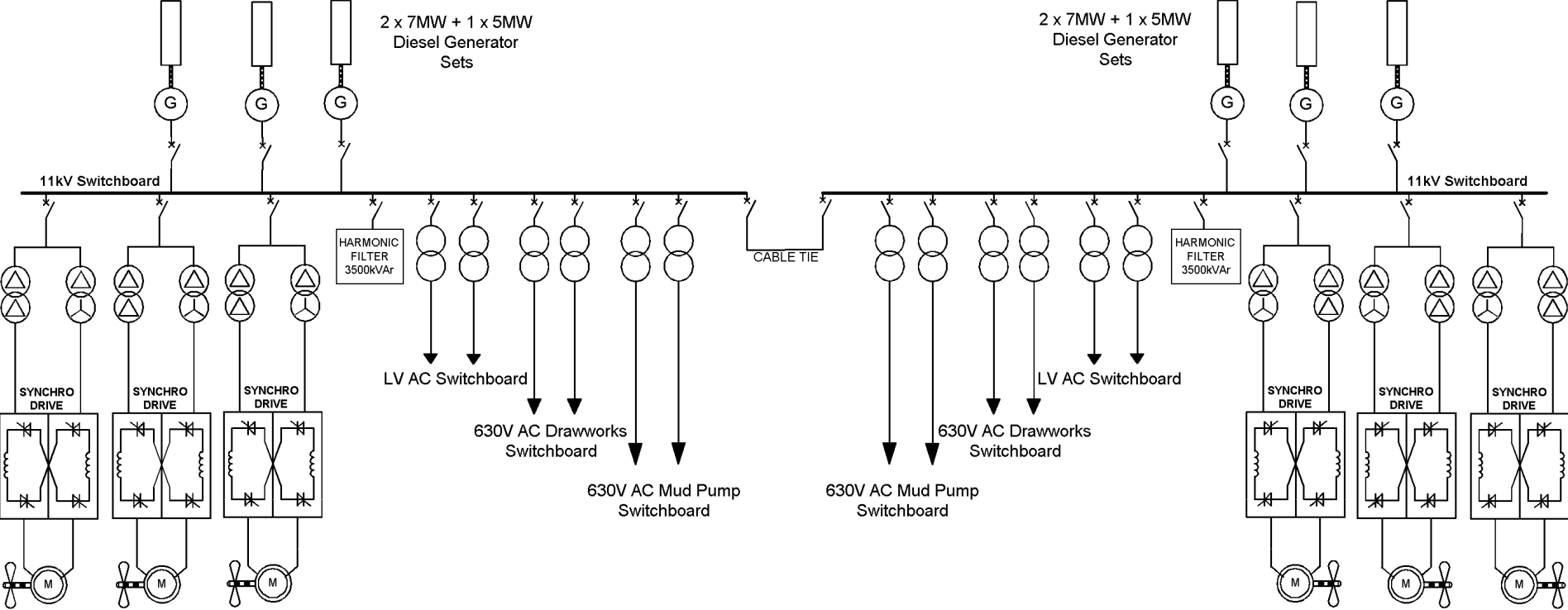
### Main electrical propulsion characteristics

**Electric propulsion :**

- 6 x 5.22 MW, 0 - 790 rpm motors**
- 6 x twelve pulse synchrodrive convertors**
- 12 x 3187 kVA transformers**

- ▼ 11kV Switchboards
- ▼ 11kv Harmonic Filters
- ▼ 11kv/480V Service Transformers and Switchboards
- ▼ 11kV/630V Drilling Transformers and Switchboards
- ▼ 6x 5.22MW Thruster Systems Comprising
  - ▼ 11kV Transformer, 12 Pulse Pair
  - ▼ Synchroconvertor Variable Speed AC Drive
  - ▼ AC Synchronous Motor

# Discoverer Enterprise Single Line Diagram of 11kV Power System



3 x 5.22MW 720/790 RPM  
Fixed Pitch, Variable Speed  
Azimuthing Thrusters

3 x 5.22MW 720/790 RPM  
Fixed Pitch, Variable Speed  
Azimuthing Thrusters

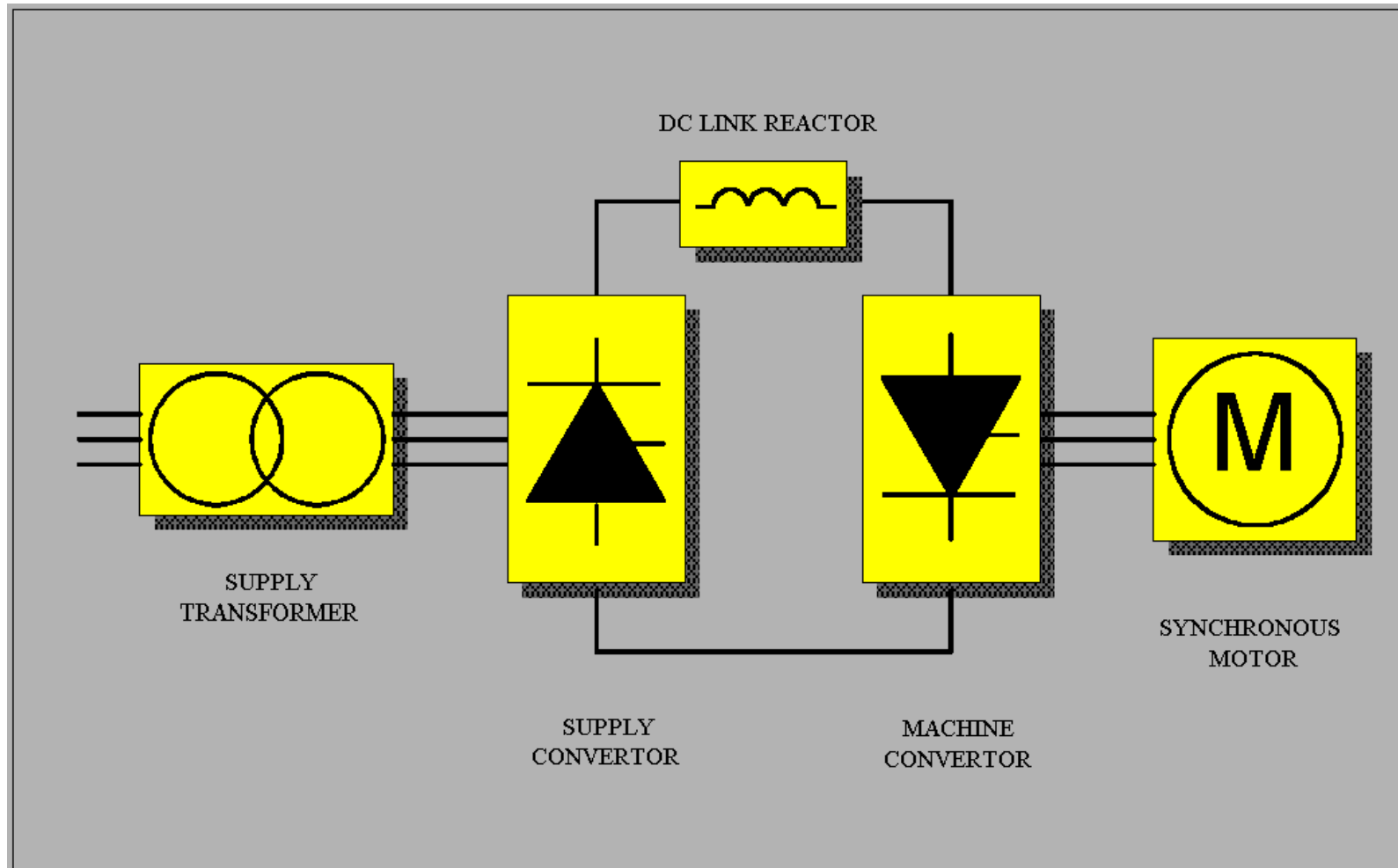


- ▼ Variable Speed
- ▼ Variable Frequency
- ▼ Fully Regenerating
- ▼ Fully Reversing
- ▼ Synchronous Motor
- ▼ High Efficiency
- ▼ Fuseless
- ▼ Simple
- ▼ Robust



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## Basic Synchroconverter Circuit Diagram





- ▼ Load Commutated Current Source Inverter
- ▼ Machine Bridges - Mains Frequency
- ▼ Supply Bridges - Motor Frequency
- ▼ DC Link with Reactors
- ▼ Mode 1 - Force Commutated
- ▼ Mode 2 - Naturally Commutated
- ▼ Standard Power Thyristors
- ▼ Encoder for Low Speeds Only
- ▼ Highly Tolerant of Supply Voltage Dips



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## **Mode 1 Operation**

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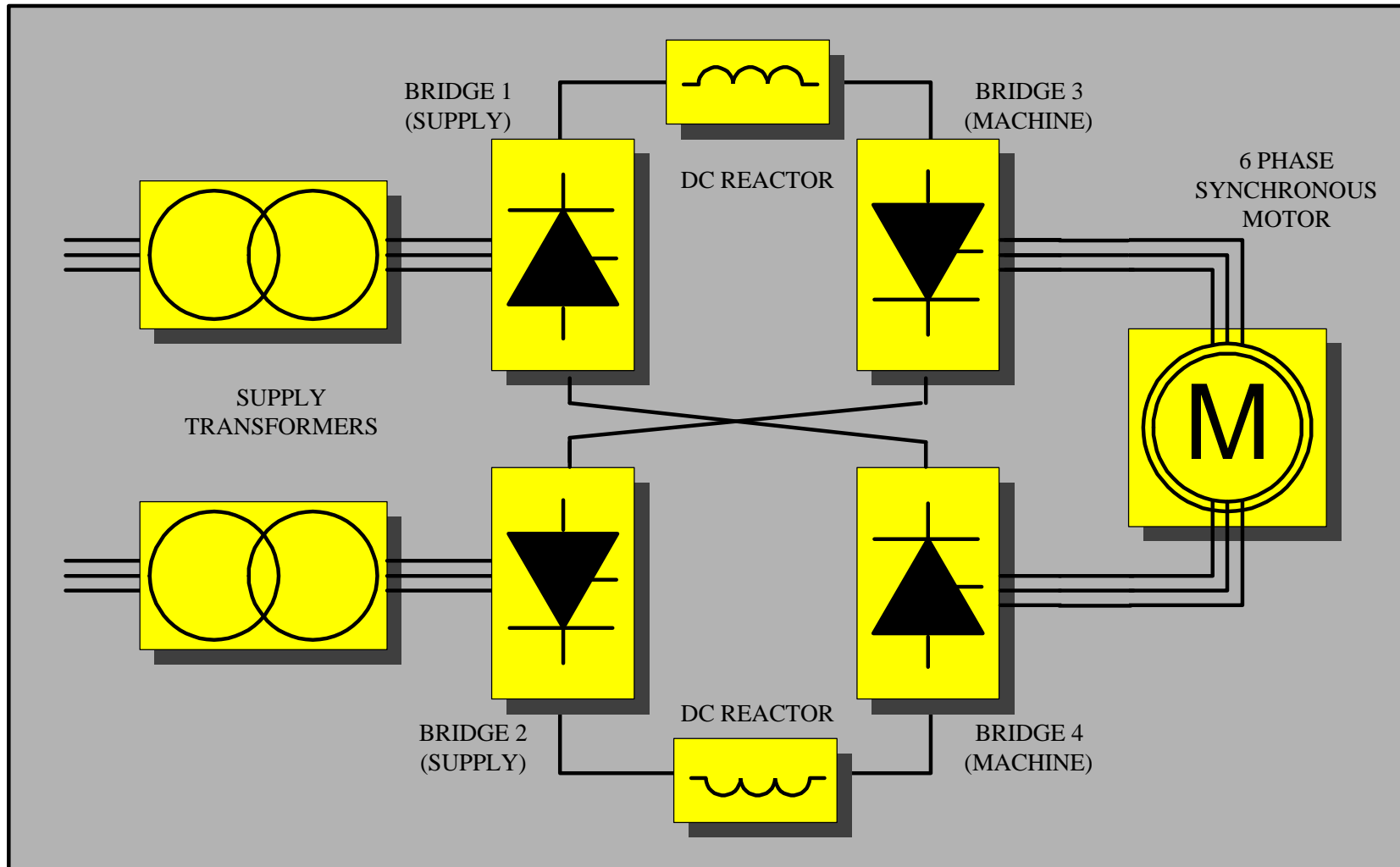
- ▼ Low Speed Operation
- ▼ Typically +/-10% Speed
- ▼ Encoder Used for Rotary Position Feedback
- ▼ Forced Commutation
- ▼ Supply Bridges used for Commutation

- ▼ Natural Commutation of Thyristors
- ▼ Machine Generated Voltage
- ▼ Above 10% Speed in Either Direction
- ▼ Speed Feedback using Machine Generated Voltage
- ▼ Position Feedback using Machine Generated Voltage



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# Synchroconverter Circuit Used In This Application





## Discoverer Enterprise Drive Supply Transformers

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- ▼ 1 x 12 Pulse Pair per Drive
- ▼ 2 x 3187 kVA
- ▼ Ratio: 11kV to 2x1266V
- ▼ Primary Connections: Delta
- ▼ Secondary Connections: Star/Delta
- ▼ 6% Impedance
- ▼ Vector Group Dy11/Ddo



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## **Discoverer Enterprise Thruster Motor**

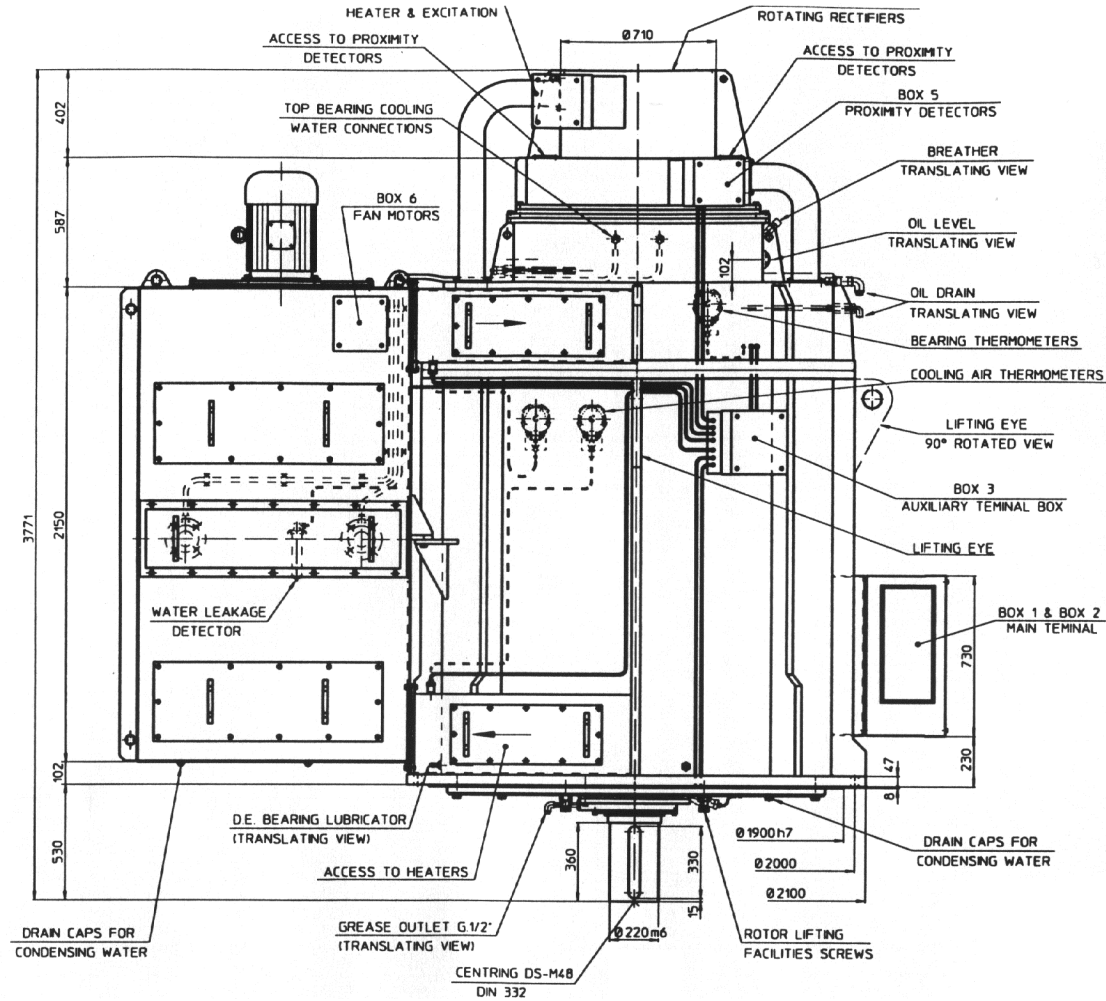
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- ▼ Synchronous Motor
- ▼ 5.22 MW
- ▼ Vertically Mounted
- ▼ Closed Air/Closed Water (CACW) Cooling
- ▼ Brushless Excitation
- ▼ 0-720/790 RPM
- ▼ 0.9 PF
- ▼ 2x3 Phase, 30 Degrees Displaced
- ▼ 0-52.7Hz
- ▼ 1250V a.c.



**CEGELEC**

# Discoverer Enterprise Thruster Motor





- ▼ Mk10 Convertor
- ▼ Closed Air/Closed Water (CACW) Cooling
- ▼ 5.22 MW per Thruster Drive
- ▼ Supply Voltage (Transformer Secondary) 2x1266 V a.c.
- ▼ Output Voltage (To Motor) 2x1250V a.c.
- ▼ 12 Pulse
- ▼ 2 Supply Bridges
- ▼ 2 Machine Bridges
- ▼ 1 Double Unit DC Reactor
- ▼ 12-1-1 + 12-1-1 Interleaved Connection



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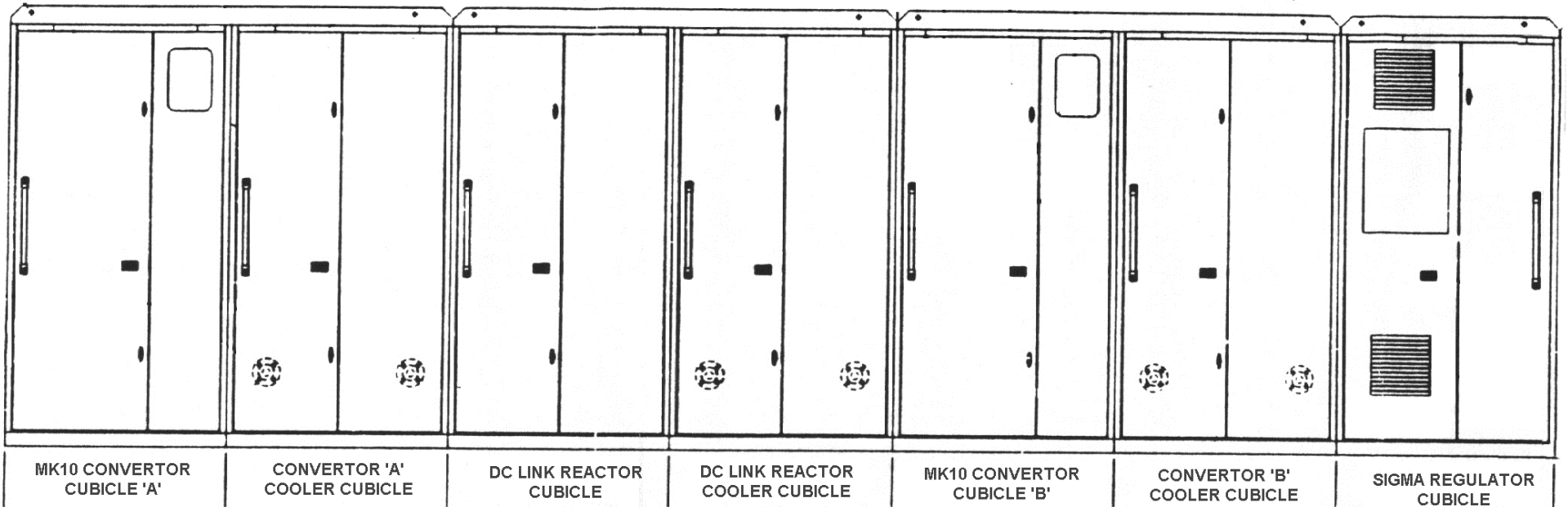
## Mk 10 Synchroconverter Cubicle Suite Arrangement (Air Cooled Variant)





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# Discoverer Enterprise Thruster Sychrodrive Cubicle Arrangement

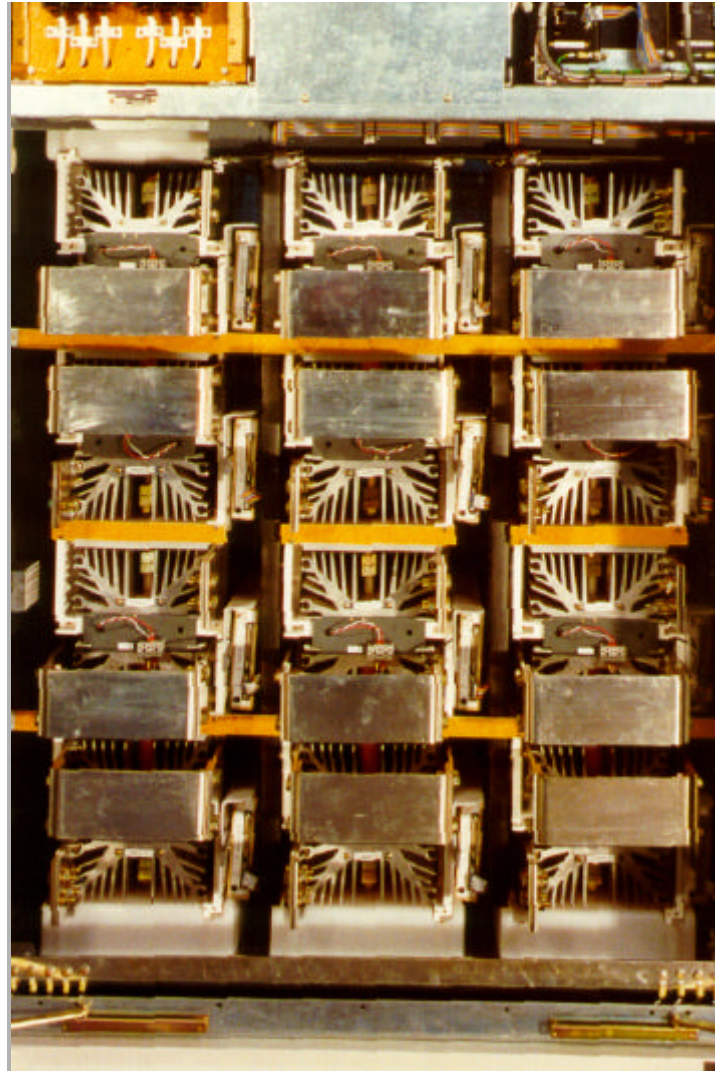




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## Thyristor Converter Front View

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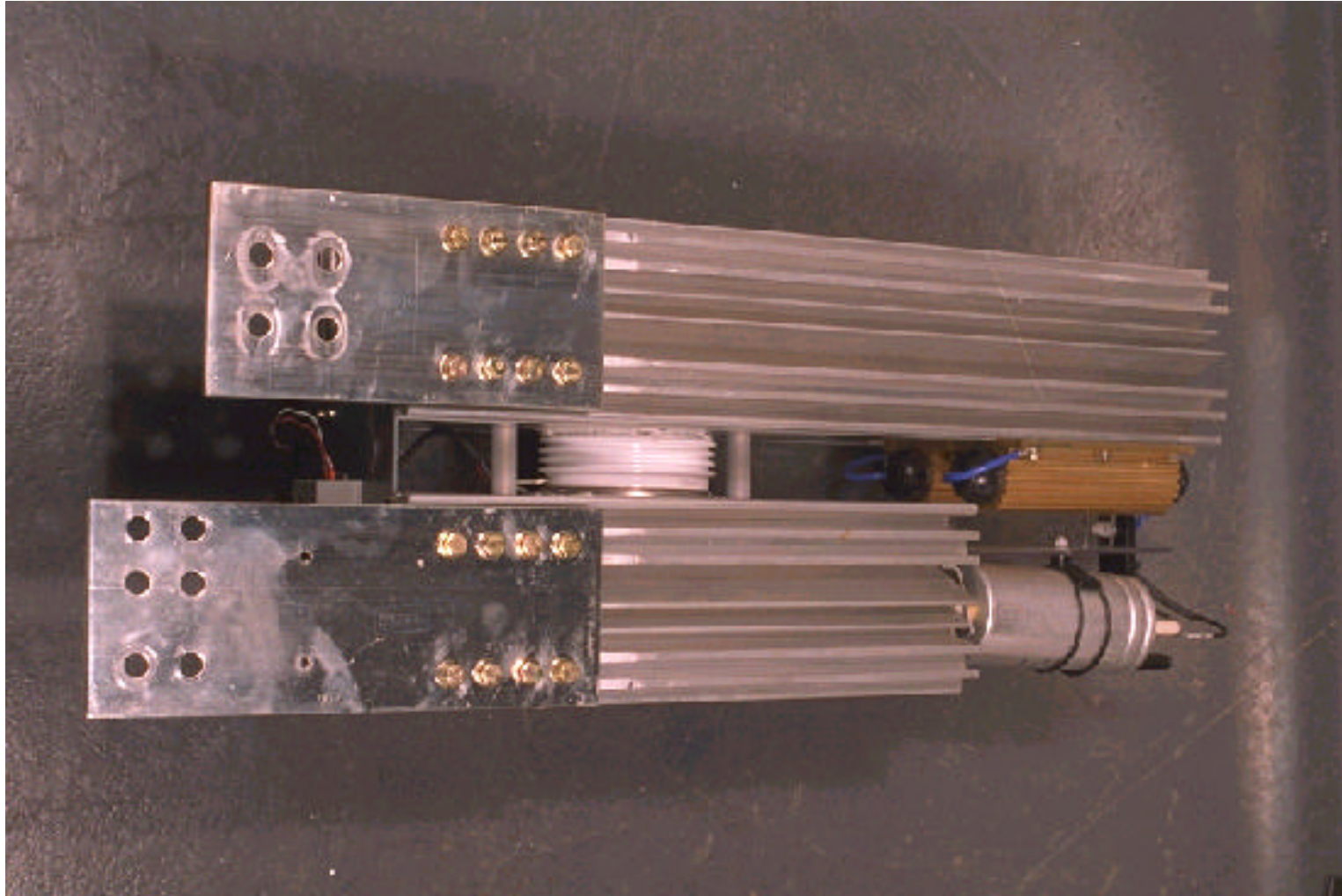


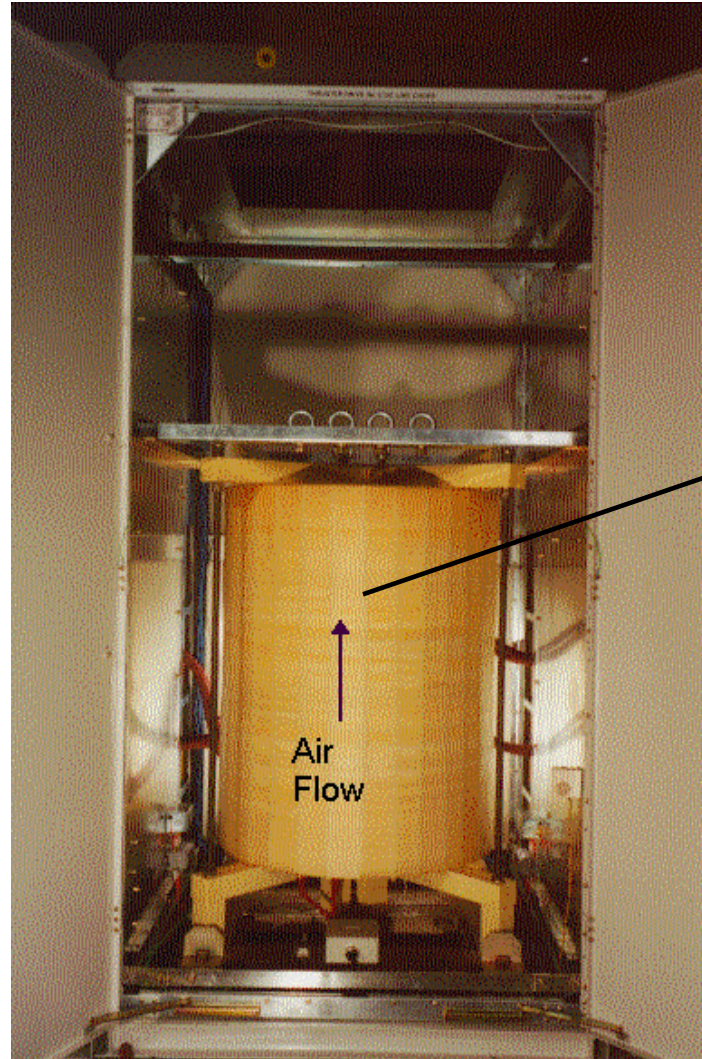


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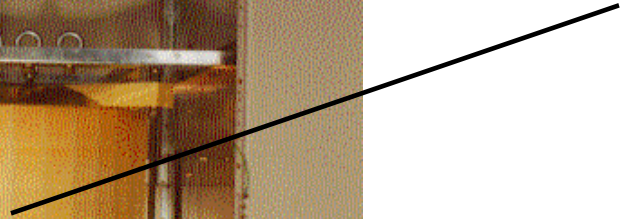
# Mk 10 Thyristor Module

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Air Cooled DC Link Reactor



Air  
Flow



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## DC Reactor Construction

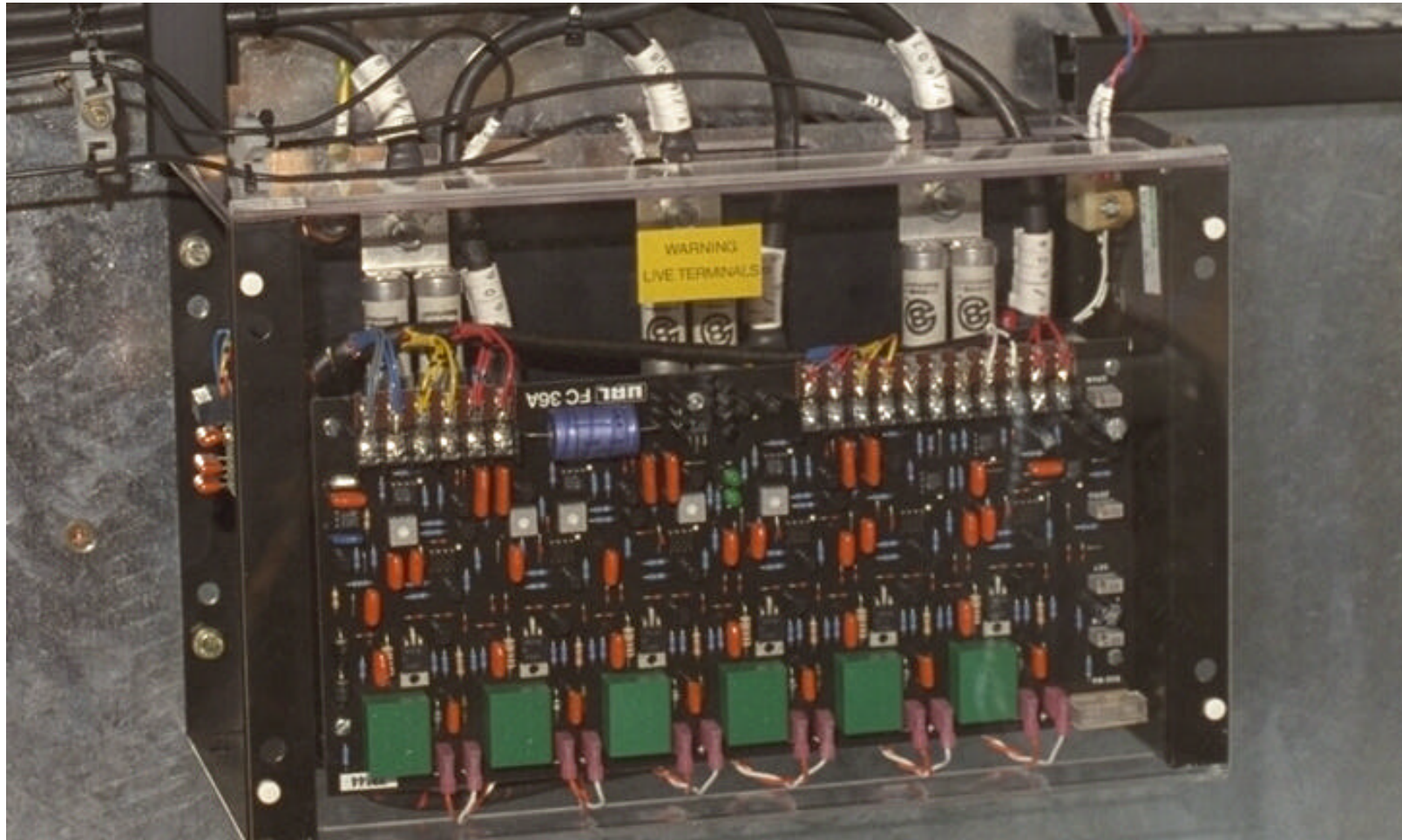
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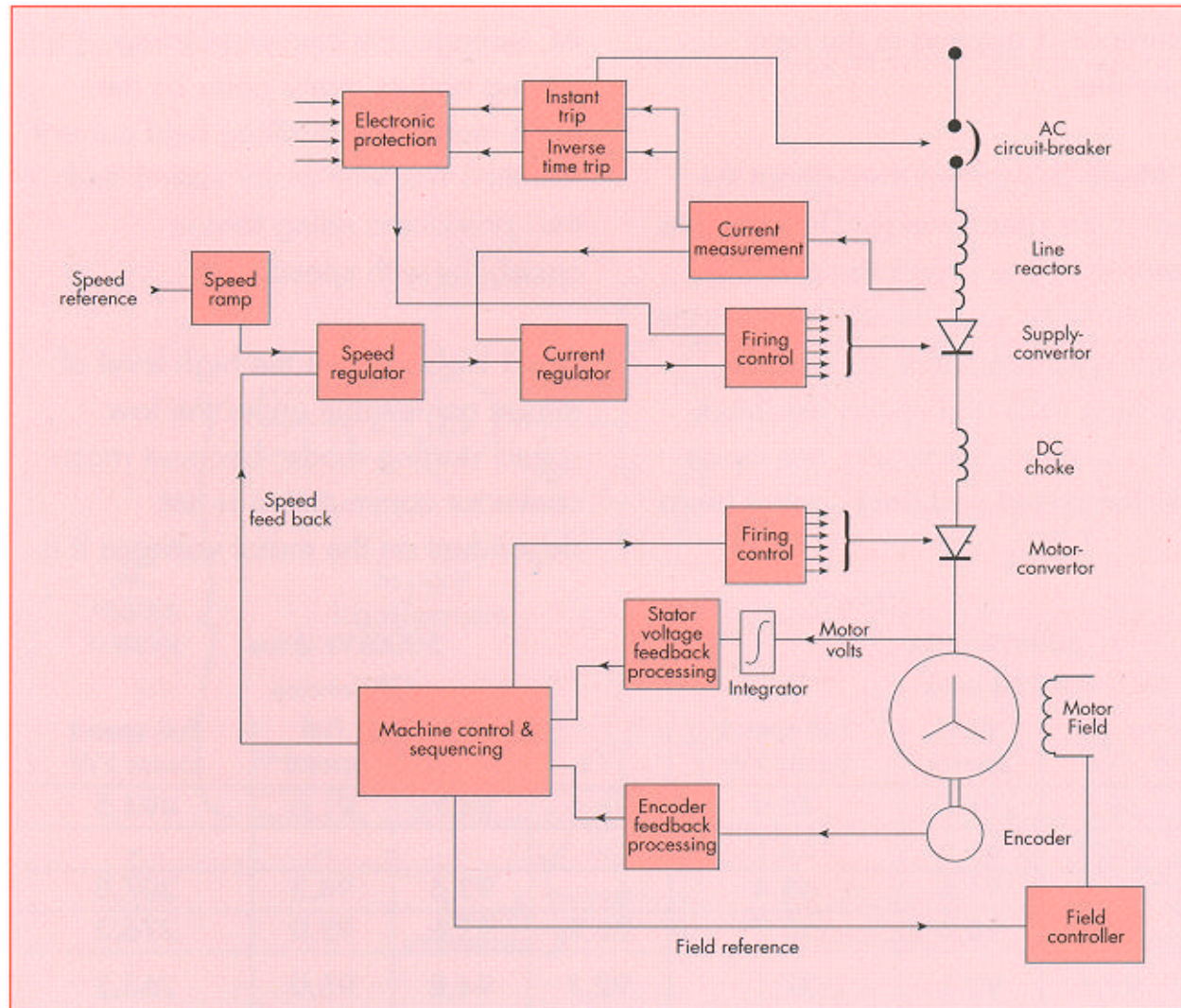
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## Excitation Controller





# Control System Block Diagram





# Sigma Controller & Type C Power Interface Box

**Sigma Controller**



**Type C Power Interface Board**

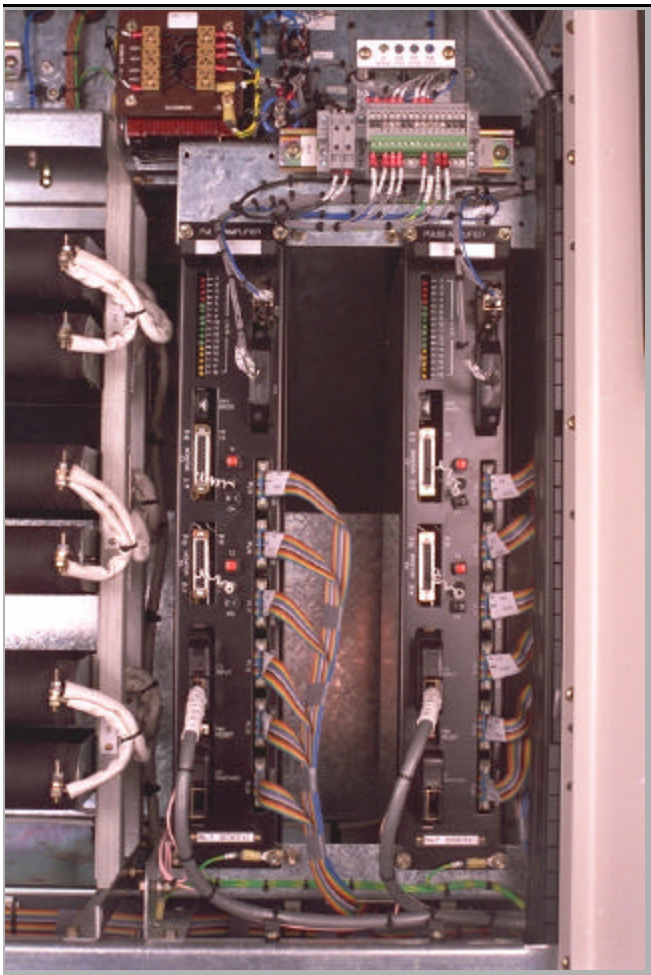




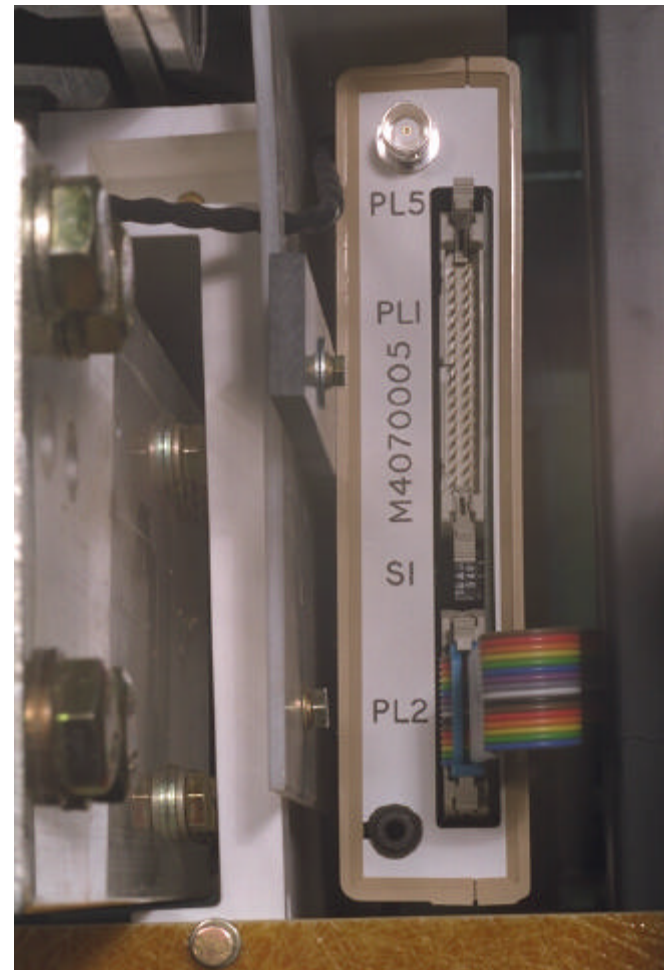
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## Pulse Amplifiers & M40 Gate Box

**Pulse Amplifiers**



**M40 Gate Box**





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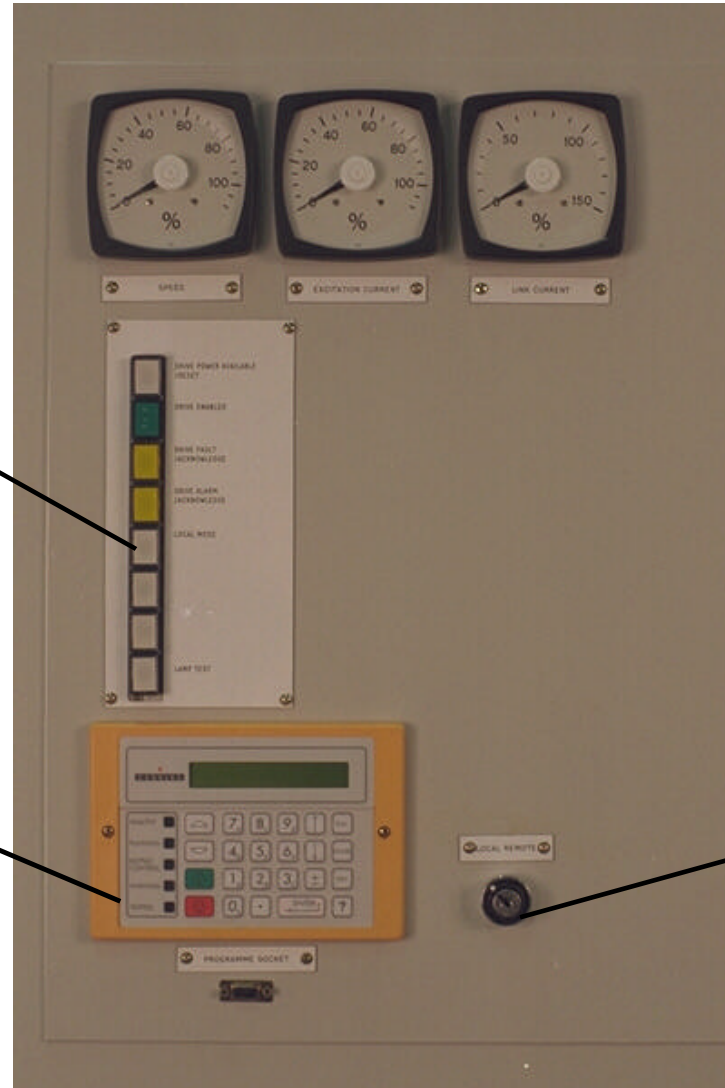
## Regulator Controls

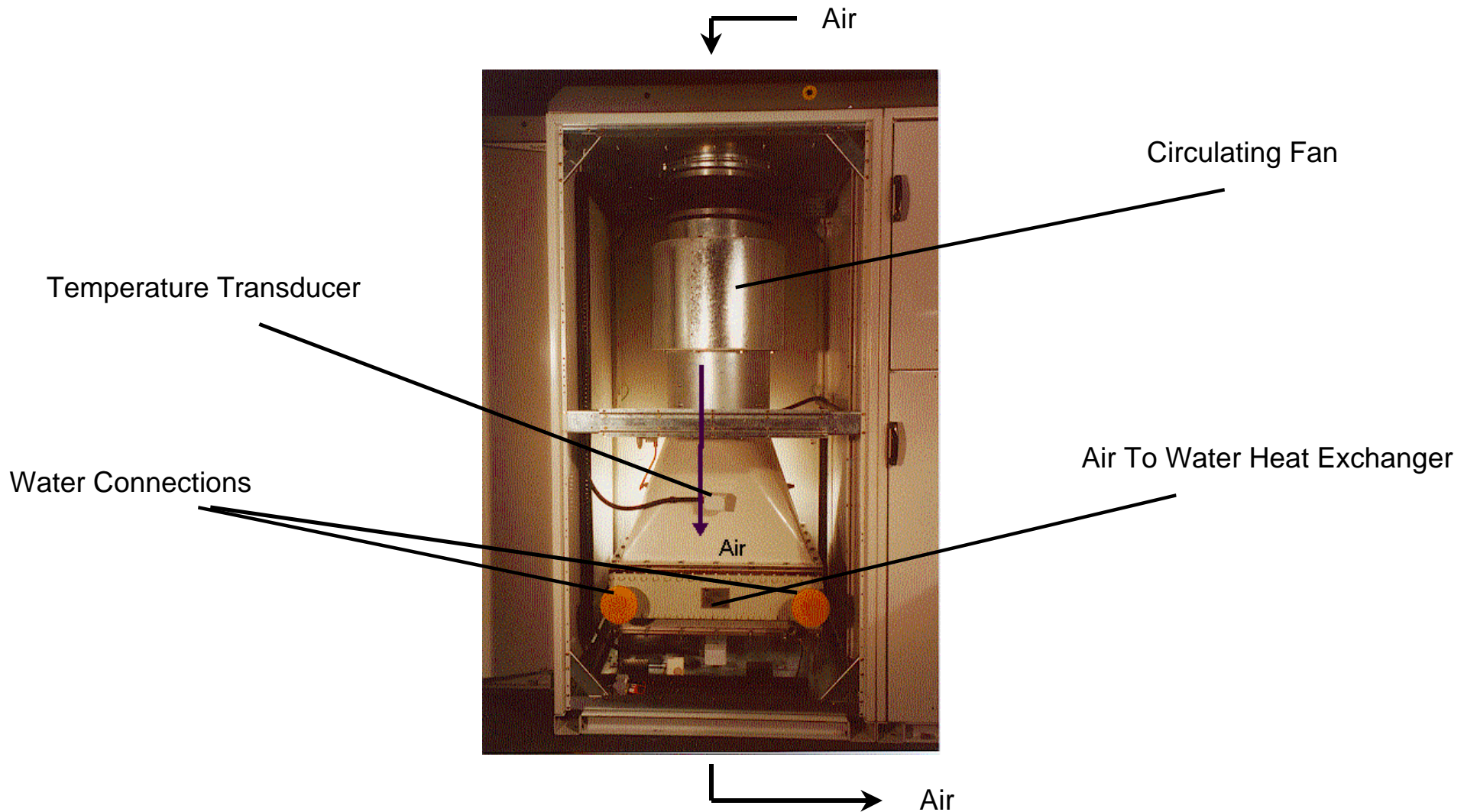
Combined lamp & pushbutton panel

RPM, Excitation, Stator Current Meters

Sigma Keypad

Local/Remote Switch





- ▼ 2 Harmonic Filters at 11kV Level
- ▼ Reduced in Size due to 12 Pulse
- ▼ 3500 KVA<sub>r</sub>
- ▼ 11kV, 3ph, 60 Hz
- ▼ 2 x LC Limbs,
- ▼ Tuned to 5th & 11th Harmonic