

20kW P.F.E. Specification 10kV and 2AMPS Reversible Polarity Power Feed Equipment - Unit Type PFE20SB

Consists of Two Racks:

Rack 1)

Power Feed - High Voltage Generator Includes:

- Clamp/Safety Chassis
- System Control Unit (SCU)
- Master SR6
- Master/Slave SR6
- Master/Slave SR6
- Patch Panel

Rack 2)

Dummy Load - Active Solid State Design - plus Autotransformer



Power Feed Equipment

The PFE will use the Spellman High Voltage Electronics SR6 Series of high voltage power supplies to derive the high voltage source and obtain the flexibility required to meet the specification outlined below and provide “Redundancy” of the power convertors. The control and monitoring functions of the system will normally be met by using a custom designed System Control Unit (SCU), which incorporates the Chart Recorder as well as the alarms, trips and ramping up and down functions. The proposed system will also allow for monitoring on the SCU and the Master SR6 Unit and, when necessary, controlling of the system by a Master Unit thus providing Redundancy within the control.

The complete system provides for a 20kWatt capability using three SR6 power supplies with constant power performance over the range 8kV to 10kV. This allows for the system to be operated at a line current level 1.6A at 8kV and below.

The following table shows the levels of output current for the number of SR6 units and output voltage. The following are some of the operating configurations (based on 20kWatts) of the system ensuring operation at 1.6Amps:

- 1 S.C.U. Control: 0-10kV @ 2.00A S.C.U. , 1 Master, 2 Slaves
2. S.C.U. Control: 0-8kV @ 1.65A S.C.U., 1 Master, 1 Slave
3. Master Control: 0-10kV @ 2.00A 1 Master, 2 Slaves
4. Master Control: 0-8kV @ 1.65A 1 Master, 1 Slaves

The reversible Safety/Clamp Chassis is used in all listed configurations. This chassis will incorporate the AC power distribution to the three SR6's and the single phase for the S.C.U. The Safety/Clamp Chassis also includes the high voltage protection diodes and the emergency output shorting relays.

The method to select the above configurations and the polarity change will be of rugged construction and easily carried out.

The electrical specification and performance of the SR6 is as per the standard data sheet attached, with detailed differences as follows:

1. The output Voltage is linearly controllable across a range from zero to a maximum 10kV with 8kV at full current and 10kV at full output power. Voltage controls are via 10-turn potentiometers fitted on the Master SR6 and SCU giving a resolution of better than 0.1% with a digital and lock. Fine control will be available on the SCU covering a range of 0-100V.
2. Output Current is linearly controllable across a range from zero to continuously rated maximums as shown with multiples of SR6's:

SR6 No	0-8kV	10kV
1	0.825A	0.666A
2	1.65A	1.32A
3	2.475A	2.00A

3. Current controls are via 10-turn potentiometers fitted on the Master SR6 and SCU giving a resolution of better than 0.1 % with digital and lock. Fine control will be available on the SCU covering a range of 0-30mA's down to 1mA..
4. LED Displays for both voltage and current is provided on the SCU, the Master SR6 and each slave SR6 derived directly from the PFE output with an accuracy of better than 1% with outputs scaled 0-10V for both voltage and current.
5. The complete system will be capable of being reversed in polarity by simply altering the position of a plug-in module at the rear of each SR6 and the Safety Chassis after powering down of the system. The system is protected until all the polarity modules are set correctly. Polarity indication will be shown on the S.C.U. and the Master SR6.
6. Current stability is better than 0.2% over any 24hour period with a temperature range of 0-40EC.
7. Current ripple will be less than 10mA peak to peak at full output current.
8. Voltage ripple will be less than 0.2% of any output voltage.
9. Monitor points will be provided on the Clamp Chassis to allow the measurement of Current ripple, and the voltage ripple using an oscilloscope.
10. The Master SR6 will incorporate a ramp up facility, the Ramp Rate controlled by a front panel mounted potentiometer covering the similar range to the SCU ramp circuit with minimum ramp time of <10 minutes, while the maximum ramp time is >40minutes.
11. The PFE is capable of operating in either Constant Current or Constant Voltage mode as required by the operator.
12. There will be an Emergency Stop Button on the Master SR6 Unit and the SCU. There will also be contact points available on a terminal at the rear of the main cabinet where further Emergency Stop circuits can be added. Indication of Voltage and Current will be shown on the Master SR6 by 3½ Digit panel meters. The Voltage shown will be the true output voltage and the current will be the total current drawn by all the SR6's.
13. The selected polarity of each of the three chassis will be displayed on the S.C.U. and the Master chassis front panel via LED indicators.
14. The PFE has the capability of operating in either Single

Equipment Summary

In order to cope with different 3-phase supply voltage and the 220VAC $\pm 10\%$ requirement of the SR6's, the equipment will be supplied with an **Auto Transformer** with selectable primary tapplings of 380/415/440V (or as required by customer specification) in its own cabinet. A single-phase 230VAC will be derived from the Autotransformer to supply the Dummy Load fans and the S.C.U.

The Power Input Required is 30KVA, with a 100Amp Circuit Breaker. Total Heat Dissipation at full output power for PFE and Dummy Load is 24kWatts.

The PFE will be supplied in an enclosed rack with shelves to hold **three SR6s, a System Control Unit (SCU), a Clamp Chassis and a Patch Panel**. To ensure appropriate cooling, a blank panel cover will be supplied to form a dummy front panel if the SCU is removed for remote operation.

The equipment is supplied with applicable cooling fans to permit continuous running at the temperatures stated. In the event of a cooling fan failure, a facility is provided to activate an alarm output. The equipment will self protect and shutdown the PFE should the temperature rise above a predetermined level. The customer should ensure that the ambient temperature does not exceed 30EC. A **Patch Panel** will be supplied with 15kV rated Lemo connectors connected to the SR6's, the Dummy Load and local and system Earths. Jumper leads will allow interconnection as required.

System-Control Unit (S.C.U.)

The S.C.U. incorporates the features to control the output voltage and current by single variable rate potentiometers, monitor output voltage and current using 4½ digital meters. Alarms will be fitted with a mute override facility and there is an Emergency Stop button included on the front panel. In addition to these features there will be Ramp Up/Down circuitry controlling the voltage at a set rate determined by the operator at rates up to 10,000V per minute. An LED displays polarity indication.

The System Control Unit (SCU) can be fitted within the Power Feed Equipment Rack or run remotely and supplied with a remote control cable of to at least 40 feet (12.2m) in length. The facilities available on the SCU comprise the following:

1. HV Switch ON/OFF.
2. Voltage control from either manual or autoramp controls and Current control from manual control.
3. Digital meter indication output volts to volt definition and output current to 1 mAmp definition. A two-stage alarm/trip system giving an audible alarm from the first preset level and a PFE output adjustable trip up to 10% for the second preset level. There is indication of status of trips and alarms as well as adjustment for both line current and line voltage.
4. Output Voltage polarity indication prior to HV switch ON.
5. A paperless chart recorder Yokogawa 4 Channel Type VR100, which will record line output current and line output voltage. This is capable of displaying real time measured data on a colour LCD and saves data on a 3.5inch floppy disk. The data saved on floppy disk can be converted by data conversion software to Lotus 1-2-3, Excel, or ASC11 format file facilitating processing on a PC Computer. This also allows a PC to display waveforms on its screen and print out the waveforms. RS-442A communication port is provided for connection to a PC.
6. Continuous monitoring of the Power Feed Rack Temperature.
7. Deviation monitoring of the set levels of both current and voltage on edgewise meters.

Dummy Load 20kWatt

The Dummy Load will be an active Solid State design allowing the load to be dynamically varied using manual front panel control or remotely allowing input voltages up to 10,000VDC and currents up to 2.5Amps. The power is dissipated in element cards fitted into a backplane at the rear of the unit. These element cards consist of commonly sourced semiconductor FET's fitted to aluminum based printed circuit boards. This arrangement allows optimum transfer of power into a cooling air flow of approximately 1m³/second. The FET's are arranged in a fault tolerant series parallel configuration where a single failure on an element card will not result in complete failure of the load. The dummy load is provided with air cooling by a fan and if the fan should fail this will result in a shut down of the dummy load to a safe condition.

The maximum load current is limited to 2.5Amps with a maximum input voltage of 10kV where the input power is limited to 20kWatts by tripping of the Power Feed. Manual control of the dummy load impedance is achieved using a front panel digital potentiometer or can be remotely controlled using a 0 to 10VDC input signal. Front Panel Controls are as follows:

POWER ON	Indicator
FAN ON	Indicator
LOAD ON	Indicator
OVER TEMPERATURE	Indicator
EMERGENCY STOP	Switch/Indicator
IMPEDANCE CONTROL	10 Turn Digital

The exhaust air temperature is a maximum of 20EC above ambient under full load conditions. The air intake has a washable filter.

PFE Operation

The Control of the PFE can be by any of the following methods:

1. The SCU to control up to three SR6's, with one SR6 configured to Master mode and the others as Slaves.
2. A front controlled Master to control itself and up to two other SR6's configured as Slaves.
3. One Slave configured to Master mode to control itself and up to two Other SR6's configured as Slaves.
4. The control of the PFE can be carried out with the SCU and any combination of SR6's.

Mechanical Construction

The proposed mechanical configuration will be for two racks, (Outline Drawing No 70175 Issue B sheet 1) where the maximum dimensions are:

Rack 1 2317mm height x 600mm width x 800mm depth Inclusive of Hood

Rack 2 1650mm height x 600mm width x 800mm depth

Deck mounting details are shown in drawing 70175 Issue A sheet 2. The Customer is required to fit deck plate for mounting the racks in the PFE room.

The Power Feed Cabinet normally includes the top hoods for the exhausting of the hot air but the extraction of air out of the room is the responsibility of the Customer.

The Cabinets are to be of proven all steel construction suitable for shipborne use. The Cabinet color is normally two tone grey RAL 7035 and RAL 7036 unless advised otherwise by the Customer. Panels are Semi Gloss Ivory to RAL 1015.

Approximate Weights

Cabinet 1:

Consisting of:

3 off SR6's at 40kg each	Total 120kg
1 off Clamp chassis	45kg
System Control Unit	15kg
Patch Panel	3kg
Fan	10kg
Rack 1	75kg
Total	268kg

Cabinet 2:

Consisting of:

Autotransformer	200kg
20kWatt Dummy Load	80kg
Rack	55kg
Total	335kg