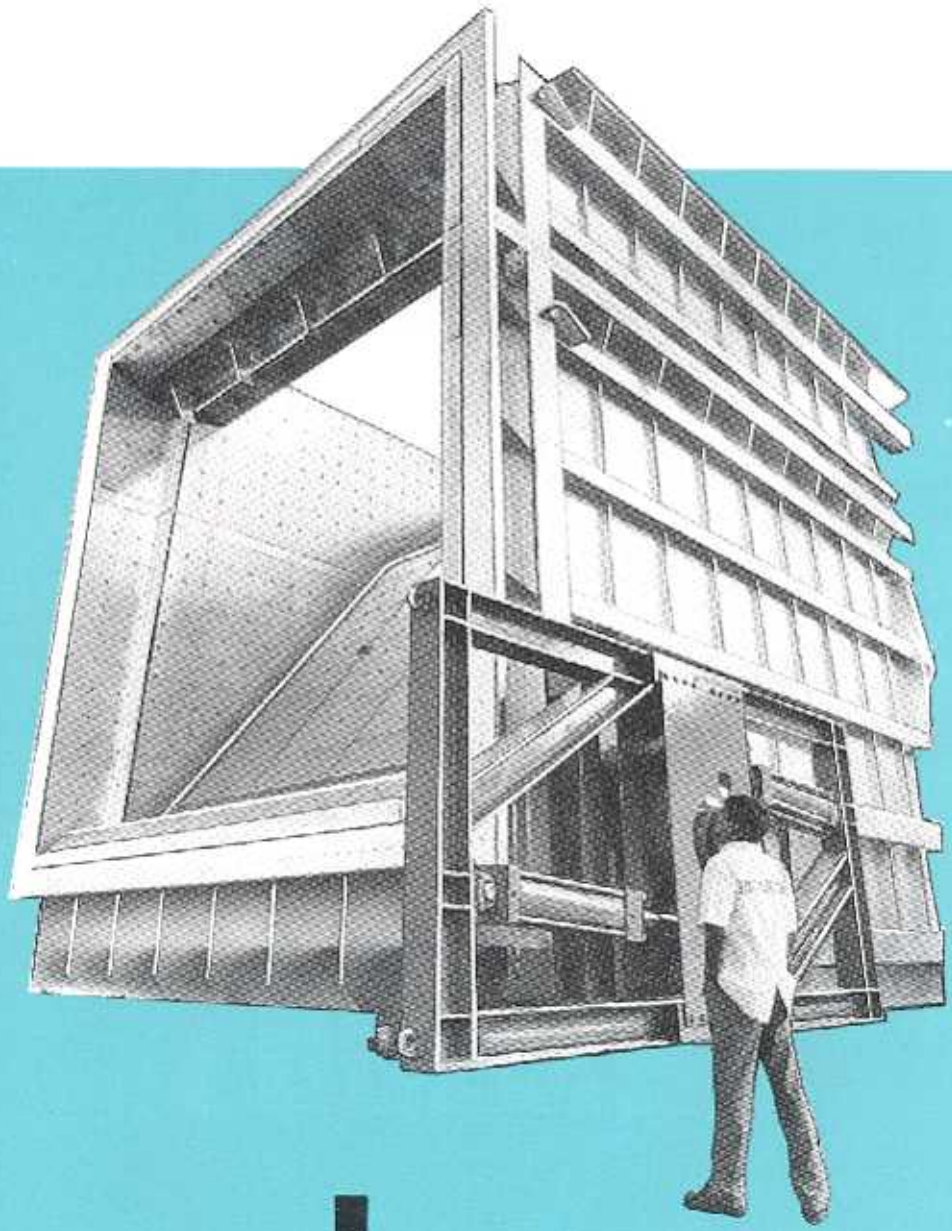
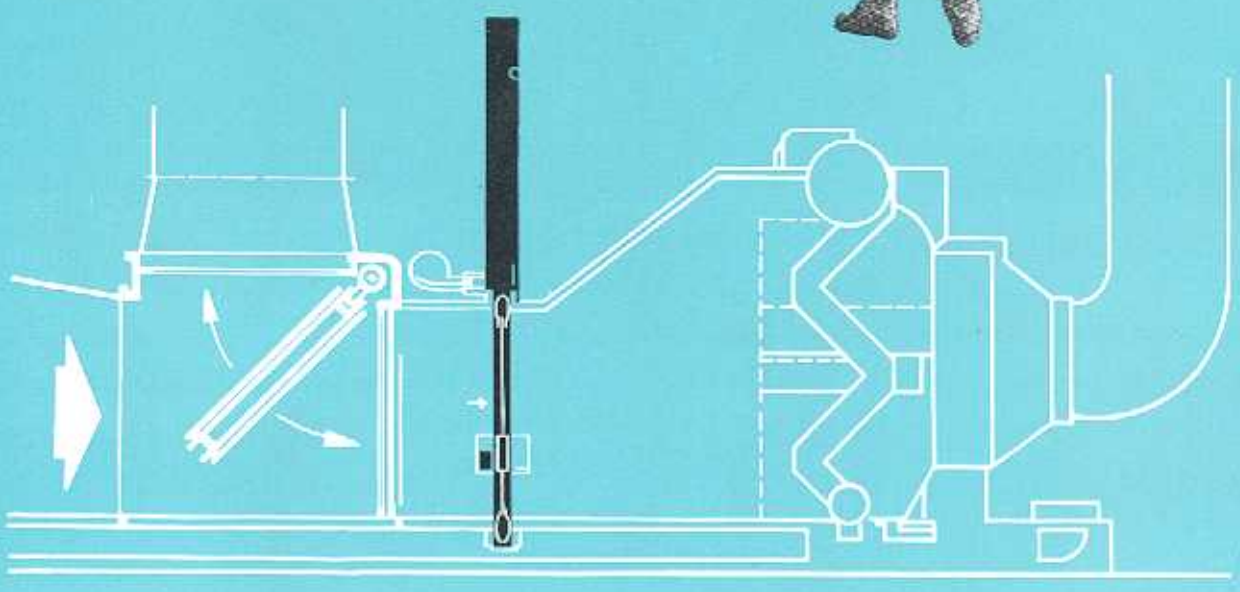
# FOURESS

## DIVERTER VALVES



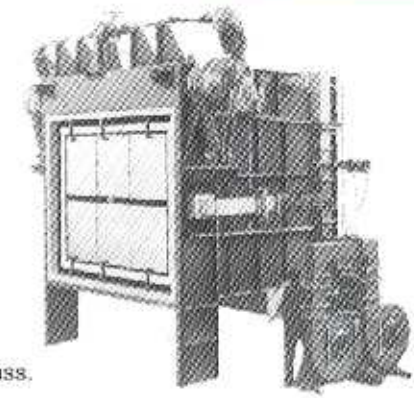


# DIVERTER VALVES

## INTRODUCTION

### GENERAL

Most gas handling systems have a requirement to change the gas flow direction to allow access to critical components, without shutting down the whole plant. With traditional dampers there is the danger of an upset, or explosion, if the two dampers do not act simultaneously. The FOURESS Diverter Valve was developed to handle such a situation in gas-turbine installations which incorporates a heat recovery boiler. Subsequently the concept has been used in a wide variety of industrial applications, such as refinery heat recovery plants, pollution control and nuclear ventilation systems and D.G. sets.



### WHY A DIVERTER ?

- ★ Improve boiler efficiency by reducing heat losses through a dump stackor by-pass.
- ★ Permit 'On-Load' maintenance of waste heat boilers, gas turbines and fans.
- ★ Ensure maximum plant safety by preventing both gas paths from being shut-off simultaneously.
- ★ Increase plant efficiency by minimising back pressure through the Isolator.
- ★ Increase plant flexibility by allowing easy and safe switching between boilers, and/or turbines.

### FOURESS DIVERTERS KEY FEATURES

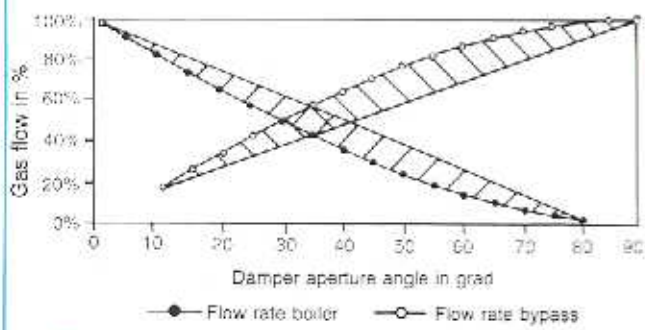
★ Floating 'Blade' assembly ★ Insulation on both outer 'Blade' surfaces ★ Minimal differential expansion in the 'Blade' ★ Pressure assisted 'Blade' seals ★ High basic Sealing Efficiency ★ Integrally stiffened Plenum ★ Suitable for external or internal insulation ★ Pressure assisted metal shaft seals ★ Self aligning bearings ★ Completely external drive system

### CONFIGURATIONS

Diverter Valves can be used where the gas is either to be directed to alternate outlets or enters the system from alternate inlets. In both cases there are two basic configurations.

### ECONOMIC EVALUATION

Diverter Valves maximise plant efficiency by reducing by-pass heat losses and having a minimum back pressure effect. For a typical gas turbine installation, compared to louvre dampers, the increased cost (if any) will be recovered in under two years. This is without assigning any value to t2he increases safety or the advantage of being able to undertake maintenance of the heat recovery steam generator without shutting down the turbine to insert a blanking plate.




### REGULATION

**FOURESS** Diverter Valves are designed with a sufficiently high natural frequency so that they can be held indefinitely, under normal conditions, at any intermediate position. Thus they can be used to regulate the gas flow, even at full load. The graph shows the flow characteristic for a typical gas turbine waste heat boiler application. The precise curve for each case is however dependent on the system layout and equipment parameters.

### FEATURES

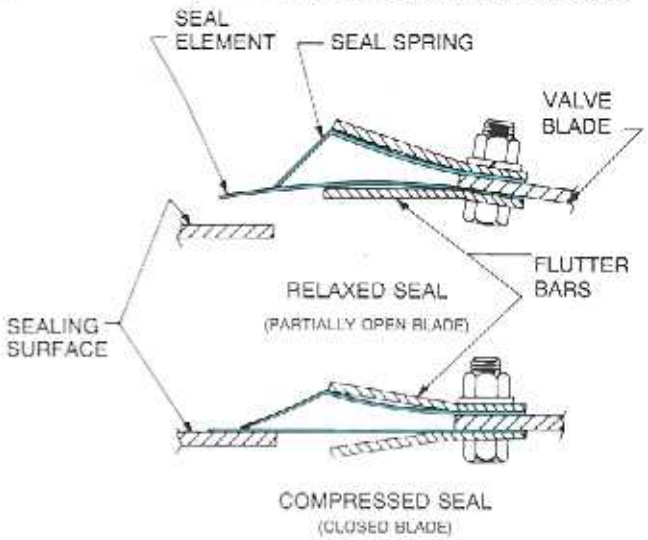
#### FOURESS FLEXIBLE METALLIC SEAL

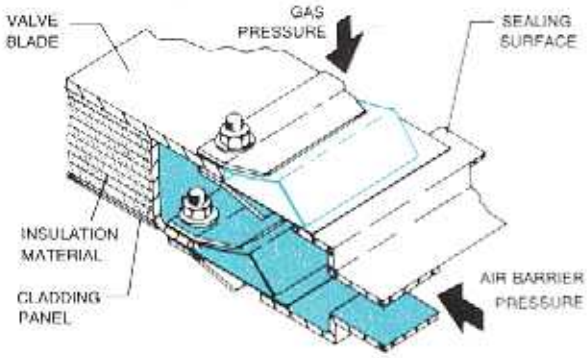
The FOURESS seal consists of a thin metal leaf strip (1) predeflected by a bias spring (2) the seal strip is pressed against the landing surface (3) forming a flat 20 mm wide sealing surface around the blade periphery. The operational deflection of the sealing element is about 17 mm and it can tolerate up to 12 mm misalignment, without any decrease in sealing efficiency. In the open position the seal is prevented from fluttering by a support plate (4) against which the seal strip is held by the bias spring.

#### ALTERNATIVE SEALING SYSTEMS

(applicable to either blade side)

**Simplex:** A sealing efficiency of 99.98%, or better, on cross-sectional area, is attained by a single row of sealing elements around the blade periphery.






**Duplex:** To attain access to an isolated section, without the need for a blanking plate, 100% isolation can be provided using a double row of seals. In the interspace a peripheral air barrier is created by a small fan, ensuring that any gas leakage is positively barred. In the event of a pressure surge or fan failure the fan ducting acts as a vent to atmosphere, enabling personnel to evacuate the isolated section.

**Twinseal:** As an alternative, with non-toxic gases, the space between the seals can be vented to atmosphere when the isolator is closed.

## INSULATED DESIGN

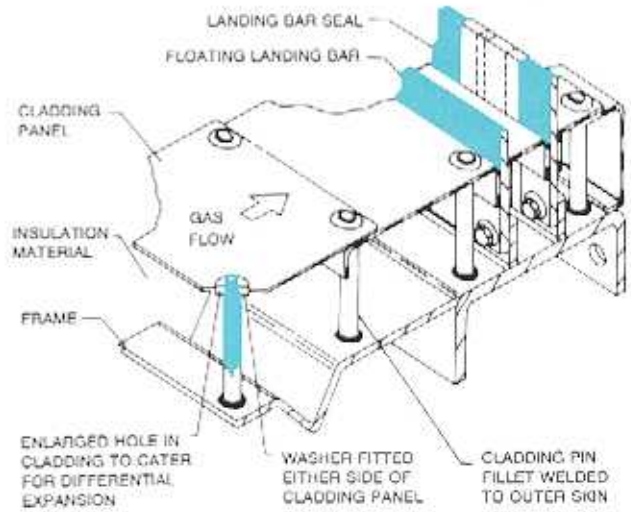
**Blade:** Heat conducted through an uninsulated steel blade represents energy losses by radiation and convection. The basic design of the isolator enables insulation to be provided on either, or both sides of the blade. This is always fitted on the cold face, to avoid the danger of distortion.

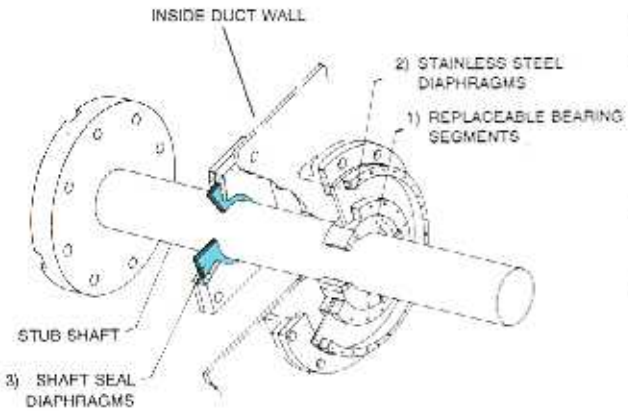
**Plenum:** The plenum chamber, which is stiffened to support the valve but not other structures, is an integral part of the unit. It can be designed for external insulation or be supplied with its own internal lining.

## INTERNAL INSULATION

Internally lined Diverters are typically fitted with ceramic fibre insulation mounted on stainless steel pins at 300 mm centres. The pins are attached to the body suing manual metal arc welding (MMAW) as this is more reliable than stud welding and preferred by most gas turbine manufactures. The insulation is then clad with 1.6 mm [3] thick stainless steel, which has the advantage of a lower expansion rate than austenitic stainless steels, fitted so as to prevent buckling of the material during operation.

In addition, to reduce differential expansion problems, the seal landing bars on internally insulated Diverters, are bolted, not welded, to the outer frame. Small seals are then used to bridge the expansion gaps between the various segments.




### High Temperature Bearings

This specially designed gun metal bearing

1) Consists of a number of replaceable segments mounted in a concentric ring, which in turn, is connected to a mounting plate by a flexible stainless diaphragm.
2) This allows the central bearing system to deflect angularly and provides the self-aligning capability.
3) The shaft seal consists of two split annular flexible metallic discs. These, mounted in a machined housing fixed to the inside of the frame, are held in place by a stainless steel plate. This enables the gland seal to float and accommodate shaft movement.

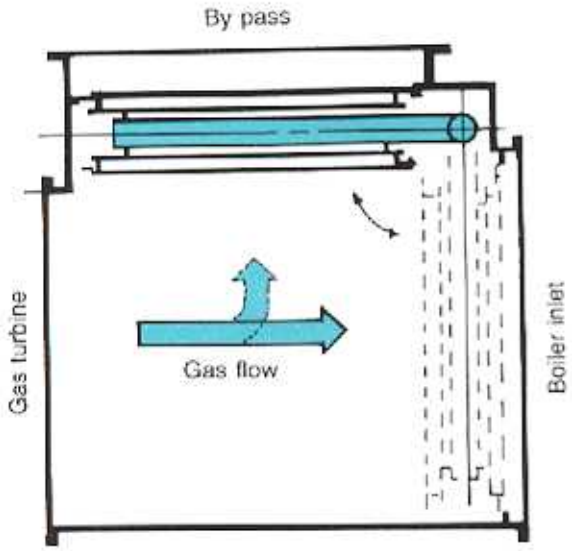
## ACTUATION

**FOURESS** Diverter Valves can be operated electrically, pneumatically, hydraulically or manually. They are supplied with single or double drive depending on the torque required to move the blade. The drive systems, which have no internal linkages, are externally mounted so as to be accessible at all times.

**STANDARD DESIGN DATA**

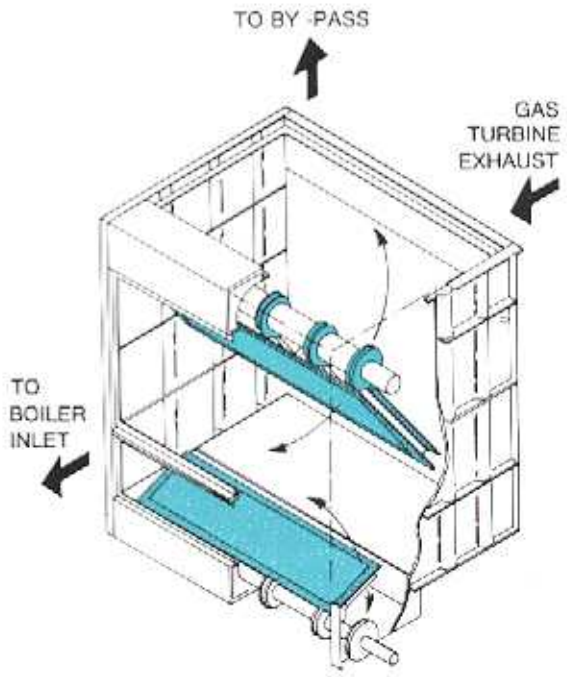
## Single Module-Multiple Module

For easy transportation and installation, individual diverter valve modules are limited to approximately 3000 x 6000 x 3000 mm. Where gas flow conditions require larger units these are created by combining a diverter valve module with individually operated single flap modules or having two or more diverter valve modules in parallel.




SINGLE MODULE

DOUBLE MODULE




## ORIENTATION

**FOURESS** Diverter Valves are suitable for installation in horizontal, vertical and inclined ducts. The main shaft can, depending on the duct layout, be arranged for any required orientation.

### GAS CONDITIONS

**FOURESS** Diverter Valves are capable of being designed to withstand temperatures and differential pressure up to 725 deg. C and 2000 mm $H_20$. Gas velocity is normally limited to approximately 30 m/s, however, with special arrangements velocities up to 45 m/s can be handled.

### CONTROL

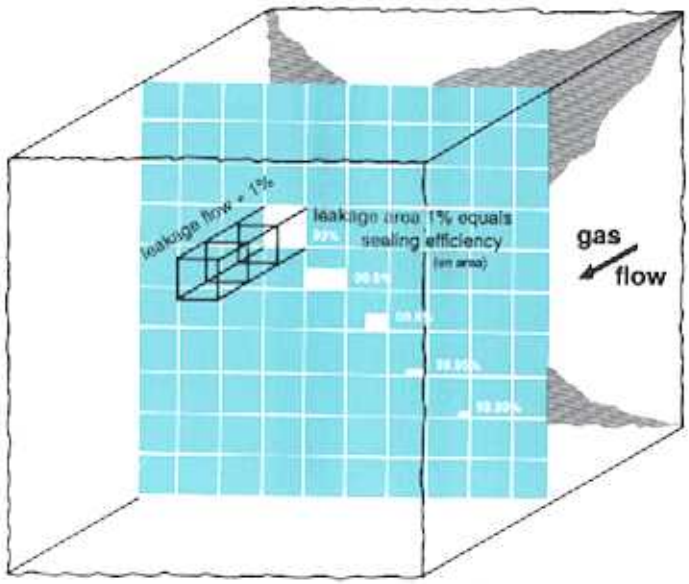
Limit switches, pairs, are supplied to control the terminal positions of the isolator blade. This facilitates interlocking with other electrical controls. For units with DUPLEX sealing system a pressure sensing device is supplied, which can be used to trigger an alarm, in the event of an air barrier failure or pressure surge in the duct

### DUST CONTROL

Where dust accumulation could interfere with proper closure of the isolator it is possible to incorporate preventive arrangements, such as a dust clearance door, hoppers, or an air purge system.

## HOW TIGHT IS GAS-TIGHT ?

The white squares in the graph represent apertures equivalent to the sum of leaking areas of equipment with the claimed relevant sealing efficiencies on cross-sectional area. However, even this does not tell the whole story. Infact, percentage volumetric leakage is equal to approximately 3 to 6 times the percentage leakage area equivalent. Thus a 99% tight damper will allow through 3 to 6% of the total gas flow.




For safe on-load maintenance only 100% gas-tight along the duct is safe enough !

## RECOMMENDED STANDARD DIVERTER SIZES

| | TURBINE DATA MW | Kg/s | C | DIVERTER OUTLETS HRSG By Pass Height Width Depth |
|---|---|---|---|---|
| ABB | | | | |
| Type 9 | 35 | 163 | 510 | 2700 x 3350 x 2700 |
| Type 8 | 48 | 180 | 523 | 3000 x 3400 x 3000 |
| Type 11D5 | 73 | 290 | 520 | 3000 x 6000 x 3000 |
| Type 11N | 82 | 316 | 545 | 2300 x 6000 x 3200 |
| Type 13D | 99 | 406 | 489 | 3350 x 6600 x 3350 |
| Type 13E | 143 | 506 | 525 | 4500 x 6600 x 3500 |
| FIAT | | | | |
| TG20 | 20 | 157 | 500 | 2700 x 3350 x 2700 |
| TG50 | 128 | 443 | 494 | 3500 x 6900 x 3500 |
| GE | | | | |
| Frame 5 | 26 | 123 | 483 | 2700 x 2700 x 2700 |
| LM 5000 | 34 | 126 | 451 | 2700 x 2700 x 2700 |
| Frame 6 | 37 | 137 | 543 | 2900 x 2900 x 2900 |
| Frame 7 | 80 | 287 | 534 | 3000 x 5586 x 3000 |
| Frame 9E | 117 | 411 | 529 | 3750 x 6250 x 3750 |
| Frame 7F | 141 | 403 | 594 | 3500 x 7400 x 3500 |
| SIEMENS | | | | |
| V64 | 53 | 172 | 536 | 3000 x 3400 x 3000 |
| V84 | 96 | 356 | 524 | 3400 x 6000 x 3400 |
| V94 | 135 | 549 | 513 | 4500 x 6600 x 3500 |
| WESTINGHOUSE | | | | |
| MW 251 | 37 | 157 | 517 | 2700 x 3350 x 2700 |
| MW 501D | 105 | 366 | 521 | 3750 x 5500 x 3750 |
| MW 701D | 122 | 450 | 512 | 3500 x 7500 x 3500 |

## The fields of applications for FOURESS Isolators extends to many industries and activities, including :

| | | |
|---|---|---|
| Cement | Nuclear | Power Generation |
| Chemical | Offshore Oil | Refuse Incineration |
| District Heating | Oil Refining | Steel- making |
| Metal Processing | Perto-Chemicals | Total Energy Systems |

## FOURESS Isolators are being used for the isolation of :

| | | |
|---|---|---|
| Precipitators | By-pass stacks | Waste Heat Boilers |
| SOx Scrubbers | Auxiliary Fans | LD Converters |
| Boilers | Fired Heaters | Sinter Strands |
| Air Preheaters | Lime Kilns | Cement Kilns |
| Reheaters | Induced Draught Fans | Spray Dryers |
| Chimneys | Pulverised Fuel Mills | Secondary Fume Systems |
| Gas Turbines | Gas Recirculation Fans | Copper Smelters |
| | | CO Boilers |

**Users of Fouress Diverter Valve Include**

Bharat Petroleum Corporation Ltd., Mahul. Fertilizer Corporation of India Ltd., Talcher. Andhra Pradesh State Electricity Board, Vijjeshwaram. Ahmedabad Electicity Co. Ltd., Vatva. Hindustan Petroleum Co. Ltd., Vizag, Samtel color Ltd., Gaziabad. Gujurat Electricity Board, Utran. Birla White Company Ltd., Ballarpur Industries Ltd., Karwar. Indian Oil Corporation Ltd., Bharauni. Essar Power Ltd., Hazira. Thermax Babcock Ltd., Pune. Indo-Rama. Soma Textile & Industries Ltd., Baramathi. Essar Projects Ltd., Hazira. Gujarat Torrent. J.K. Pharma.

**USERS OF FOURESS GAS-TIGHT ISOLATORS INCLUDE:**

(A) **POWER PLANTS :** Port Kelang (Malaysia); MSEB (Koradi, Nashik, Bhusaval, Parli); MPEB Korba, Sarni, Amarkantak); GEB (Ukai, Wanakbori); TNEB (Ennore, Tuticorin); APSEB (Kothagudam), OSEB (Talcher), NTPC (Badarpur, Farakka, Ramagundam, Singrauli), UPSEB (Panki); Renusagar Power Corporation Ltd., (U.P) BSEB (Patratu, Barauni), HSEB (Faridabad, Panipat).

(B) **DESULPHURISATION PLANT :** Tata Electric Company, Trombay.

(C) **CEMENT PLANTS :** Sharjah Cements (UAE); Padang Portland Cements (Indonesia); ACC (Gagal, Kistna, Porbandar, Sevalia, Wadi, Chanda); Andhra Cement Company Ltd., (Durgapuram); CCI (Manikgarh, Neemuh, Tandur, Yerraguntla); Gujarat Ambuja Cements; Kesoram Cements; L & T (Awarpur); Madras Cements Ltd; Mysore Cements Ltd; Priyadarshini Cements; Rajashree Cements; Modi Cements; Saurashtra Cements; Vasavadatta Cements; Mangalam Cements; TISCO Cements; Dhar Cements; Vikram Cements; Raymond Cements; Texmaco (Yerraguntla) Jaypee, Rewa.

(D) **REFINERY & PETROCHEMICALS:** Gujarat Refinery; Gauhati refinery; Mathura Refinery; Barauni Refinery; Cochin Refineries, Bongaigaon Refinery; Haldia Refinery (IOCL); Madras Refinery; HPCL (Vizag), BPCL (Bombay); Tamil Nadu Petroproducts Ltd. Reliance Petrochemicals Ltd. (Hazira) Cochin Refineries.

(E) **GAS TURBINE :** ONGC (Hazira, Uran); BPCL (Mahul); FCI (Talcher); APSEB (Vijeswaram); AECO (Vatva); HPCL (VIZAG); GEB(Utran); Samtel (Ghaziabad)

(F) **NUCLEAR :** IGCAR (Kalpakkam); KCR (Khammam).

(G) **PAPER :** National Newsprint & Paper Mills (Nepa Nagar); Ballarpur Industries Ltd., Orient Paper Mills (Amlai), Century Paper Mills.

(H) **FERTILIZER :** Shriram Fertilizers & Chemicals Ltd. (Kota); HPCL (Barauni), Zuari Agro Chemicals Ltd. (Goa), SPIC (Tuticorin).

(I) **STEEL :** SAIL (Rourkela Steel Plant, Bhilai Steel Plant, Bokaro Steel Plant).


**FOURESS**
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