1X660 MW BHUSAWAL TPS UNIT 6

TECHNICAL SPECIFICATION

FOR

FIRE SEALING SYSTEM (Mortar Based)
SUPPLY & INSTALLATION

VOLUME-II

SPECIFICATION NO: ***PE-TS-415-507-E016***

REVISION: **0**

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, UP (INDIA) – 201301

	TECHNICAL SPECIFICATION FOR FIRE SEALING SYSTEM SUPPLY & INSTALLATION	SPECIFICATION NO. PE-TS-415-507-E016
		VOLUME II
		SECTION
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COMPLIANCE CERTIFICATE

The bidder shall confirm compliance to the following by signing/ stamping this compliance certificate and furnishing same with the offer.

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same.

2. There are no deviation with respect to specification other than those furnished in the 'schedule of deviations'.

3. Only those technical submittals which are specifically asked for in NIT to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of offer.

4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.

5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in 'BOQ-Cum-Price schedule' of the specification shall not be considered (i.e., technical description & quantities as per specification shall prevail).

BIDDER'S STAMP & SIGNATURE

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SECTION – I

STANDARD TECHNICAL REQUIREMENTS

BHEL	TECHNICAL SPECIFICATION FOR FIRE SEALING SYSTEM SUPPLY & INSTALLTION	SPECIFICATION NO. PE-TS-415-507-E016
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1.0 PURPOSE

This specification is intended for finalization of contract between BHEL PEM and Bidder for supply & E & C of Fire sealing system. Technical detail as indicated in the specification shall be agreed upon between BHEL PEM and bidder.

2.0 SCOPE OF ENQUIRY

2.1 This enquiry covers the Design, manufacturing, inspection & testing at manufacturer's works, proper packing, delivery to site, handling and erection & commissioning of **Mortar based Fire Sealing and fire coating System** for cable openings through walls, floors & below panels, pipe sleeves and fire protection coating on installed cables conforming to this specification.

2.2 It is not the intent to specify herein all the details of design & manufacture of material. However, the material shall, conform in all respects to high standard of design, engineering and workmanship and shall be capable of performing in continuous commercial operation at site conditions.

2.3 Technical requirements of the **FIRE SEALING SYSTEM** are indicated in Datasheet-A and Section-II.

2.4 The stipulation of Data Sheet-A shall prevail in case of any conflict between the stipulations of Data Sheet-A & Section-II.

2.5 Purchaser reserves the right to increase / decrease the quantity as finally required for the Project. Unit rates quoted by the bidder shall be applicable for adjustment purposes for the same.

3.0 <u>System Description</u>

The system provided for fire sealing for various openings in cable vault, vertical/ horizontal raceways of cables penetrating walls/floors and the bottom of Electrical switchgears and panels in control Equipment room/MCCs/Distribution Boards/Cabinets/Panels shall be provided with fire stop systems of 3 hours rating.

Fire sealing system offered shall be of Powder/ mortar based sealing system. The system shall be of type-tested design as per national/ international standards e.g. ASTM-814/ BS: 476. Shelf life of fire sealing & coating compound shall be 1 years in original unopened packing stored in a dry place.

3.1 Fire Stop Mortar Seal shall be installed at TG building including switchgear rooms, cable vaults, control room etc, ESP building/ areas, Boiler areas & other offisite areas in the plant.

(i) Control Room / Cable Vaults and in plant area.

a) Panel bases in control room shall be sealed.
b) All wall openings and floor openings in control room / cable vaults shall be sealed.
c) All cable entry openings from trenches or overhead cable trays racks shall be sealed.

(ii) Trenches

a) Barriers shall be installed inside the trenches at every intersection or Tee joints and bends at every 2 meters from center line of cable rack inside the trench.
b) Barriers shall be installed at every 15 meters in straight runs of trenches.

3.2 Fire retardant coating shall be provided for 500mm length and the thickness of the coating compound shall be 2mm which shall be sufficient to achieve 30 minute fire rating. Fire Protective Coating shall be applied at following locations.

(i) Control Room / Cable Vaults and in plant area.

a) All vertical cables coming out below the panels shall be coated to a full length of vertical drop from bottom of panel plus 1.5 metres horizontal runs after the bend.
b) All Vertical cable runs are to be coated full.
c) All horizontal cable runs to be coated for a length of 1.5 metres at an interval of every 3 metres. At bends/ intersections and Tee joints, coating shall be done 2 metres from centre line of cable tray on each side.

(ii) Trenches

(a) All vertical cables coming down into the trenches from the equipment shall be coated at interval of 5 metres for a length of 500mm.

(b) At the intersection / joints / bends in the trenches all cables to be coated 2 mtrs from center line of the cable tray rack.

(c) All horizontal cable runs to be coated for a length of 3 mtrs in the center of every 15 mtrs i.e. at the center of two fire stop mortar seal barriers and in the same proportion if the distance is less than 15 mtrs and more than 6 mtrs.

3.3 Type tests on fire stop mortar seal & fire retardant coating for floor/wall opening/fire stop system for bottom of electrical switchgear MCCs/Panel are as under:
a) Water absorption test.
b) Vibration test.
c) Fire rating test.
d) Hose stream test.
e) Accelerated ageing test.
f) Temperature rise test for cables in fire stop
g) Anti-rodent test

3.4 Type tests for fire proof cable coating are as under:
a) Flammability test (IEC-60332-3-32).
b) Limiting oxygen Index test (ASTMD-2863), limiting oxygen index of the material shall greater than 60%.

Bidder to note that type tests as per clause no. 3.3 & 3.4 above are to be conducted in presence of owner's representative, for this project as per latest applicable standard for Fire Stop Mortar seal & for fire proof cable coating for floor & wall opening/ fire stop system for bottom of Electrical switchgear/ MCC/ panel base.

3.5 **Test Details**

a) Fire Rating Test

This test shall be carried out to prove the guaranteed power rating duration of the system in respect of stability, integrity and insulation characteristics of the complete system. The penetration seal system as a whole conforming to ASTM 814 and as per BS:476 Part-8 shall be built with the necessary component. The fire test shall be built with the necessary component. The test specimen of the penetration seal built with 9-10 nos. armoured cables of various sizes passing through the seal shall be fitted to the gas fired furnace and shall form the upper most face of the furnace. The gas fired furnace shall have provision to achieve standard time temperature characteristics for fire tests as mentioned in BS-476 Part-8, according to which the temperature required to be maintained are as under:

Heating time in minutes	**Temperature in the furnace**
30 minutes	821°C
90 minutes	886°C
120 minutes	1029°C
150 minutes	1062°C
180 minutes	1090°C
210 minutes	1113°C
240 minutes	1133°C

The pressure inside the furnace at the time of test shall be more than 2 mm water gauge. The penetration shall be subjected to fire test with surface exposed to controlled fire in the furnace conforming to time / temperature characteristics as mentioned above. During the test, the temperature of both the faces of the penetration seal i.e. one which is exposed to fire and the other unexposed, shall be measured by calibrated thermocouples after regular interval of 5 minutes. At least 3 thermocouples shall be provided for temperature measurement of each face.

The results at the end of the tests shall be interpreted or failure criteria as under:

i) The system is deemed to have failed to maintain stability if there is a total collapse of the penetration seal.

ii) In case cracks are seen on the face of the penetration seal or cracks through the sealing system through which the flame / or gas can pass, the system is deemed to have failed to maintain integrity. The development of crack is characterized by ignition cotton wool held near the seal on the unexposed surface at a distance of about 30 mm from the aperture.

iii) In case the mean temperature rise of unexposed surface of seal exceeds 140°C above the initial temperature or temperature of unexposed surface exceeds 180°C, the system shall deemed to have failed in respect of insulation characteristics.

iv) Temperature measurement on the unexposed side of the penetration seal specimen shall be measured by the thermocouple on the surface of penetrating items and on fire stop material in accordance with ATME-814/UL 1479 at a distance of 25 mm from fire stop material and penetration items respectively.

b) Hose Stream Test:

The intention of the hose stream test is to ascertain whether the penetration seal assembly maintains its stability on application of water jet after withstanding the fire for 3 hours i.e. the guaranteed fire rating duration. The test apparatus for this test shall be similar to the one used for carrying out the fire rating test. The penetration seal system shall be subjected to the action of hose stream at the nozzle pressure of 30 psi supplied for a duration of 1.5 sec./ sq.ft. of exposed area. The hose stream shall be

applied with 1.1/8" dia. nozzle at a perpendicular distance of approximately 17 ft. from the centre of the assembly on a line approximately 270 deg. from the line normal to the centre for the test assembly. The water stream shall be applied within 4 minutes and 30 seconds after completion of fire rating test. However, this period shall not exceed more than 10 minutes in case of practical difficulties experienced by testing stations. The application of water stream shall be maintained throughout the test duration and shall traverse the complete fire stop system. The fire stop assembly is deemed to have passed the hose stream test successfully if no through projection of water is noticed on the unexposed surface of the seal. Further on completion of hose stream test, the appearance of the penetration seal system shall not alter substantially indicating thereby that the stability of the system ahs been maintained.'

c) Accelerated aging test

The intention of accelerated aging test is to ascertain whether the artificial aging of the systems and components thereof results into change in the mechanical properties or in the form. In order to simulate aging, artificial aging shall be resorted to.

For the purpose of subjecting the penetrations seal system components to accelerated aging, the system / components shall be stored for 336 hours in air furnace where the temperature of the inside air, shall be maintained at 100 degree centigrade. However, for system components in pliable form, system component shall be stored for 448 hours in air furnace where temp. of air inside the furnace shall be maintained at 75°C. It is assumed that the changes occurring during test period would roughly correspond to the effect on aging over a period of about 40 years. After completion of 336 hours / 448 hours, the mechanical properties such as tensile strength element, elongation and hardness of the material (as may be applicable) shall be tested. This results shall be compared with corresponding values before subjecting to accelerated aging test. The change in the form of system / components shall also be compared with the form before the tests to ascertain whether the system / components thereof have undergone any permanent change. In case the mechanical properties before and after the accelerated aging do not indicate substantial change, the system shall be deemed to have passed the accelerated aging test. Similarly, the variation in the form of the system components at the end of the test shall not indicate permanent deformation which is likely to affect the ceiling properties of the system.

d) Fire Rating test After Accelerated Aging:

Intention to this test is to ascertain whether the penetration seal built out of components already subjected to accelerated aging still passes the fire rating test for guaranteed fire rating duration.

The test apparatus for this test shall be similar to the one used for fire rating test mentioned above. The assembly or the penetration seal shall be carried out with the components which were subjected to accelerated aging test based on the test procedure mentioned above. In case there is a problem of co-ordination with the test station, the prototype assembly may be subjected to aging in manufacturer's works under the conditions mentioned above and live fire test should be carried out at manufacturer's works in presence of Owner's representative. In live fire test, the temperature of fire shall be of the order of 1000 deg.C at the end of 3 hours. The test shall be carried out at atmospheric pressure. The interpretation of test results for failure shall be similar to those mentioned under fire rating test/live fire test at (7.4) - (a) above.

e) Temperature rise test for cable in the fire stop:

This test shall be carried out to ascertain whether due to inadequate dissipation of heat at the location of fire stop, the temperature of cable conductor or outer sheath in contact with the fire stop, rises beyond the acceptable limits due to which whether any derating is required for cables.

Fire stop systems hall be erected with, at least 8-10 armoured cables, specially power cables. While laying the cable through penetration seal, thermocouple shall be placed on the outer surface of cable in contact with the fire stop system. The location shall be selected where there exists possibility of inadequate dissipation of heat from cables to the atmosphere due to fire stop components. Two thermocouples shall also be located on the two surfaces of the fire penetration seal system. Similarly thermocouples shall also be placed on the other surface of cables where there exists contact of

free air without any obstruction so as to enable adequate nature cooling. In case the temperature of outer surface of the cable in contact or inside the fire stop system does not exceed 75 degree centigrade, it is inferred that no derating of cable is required for cable when used in conjunction with the particular fire stop system. Test shall be repeated with reduced current till the temperature of cable outer surface in contact with fire stop system is limited to 75°C. The rate of the current so guaranteed by the cable manufacturer as free air rating shall be
the derating factor.

f) Water Absorption Test:

The test specimen shall be immersed in fresh clean water at a temp. of 20°C. The test specimen must be separated from the bottom and sides of the soak tank by at least 10 mm and it shall be covered by approximately 25 mm of water. At the end of the 24 hours soak period, the specimen shall be removed from the water and moped up with a damp cloth. Fire rating test after water absorption is to ascertain whether the penetration seal subjected to water absorption still passes the fire rating test for guaranteed fire rating duration. The test apparatus for this test shall be similar to the one used for fire rating test at Sr. No.7.4 (a). In case there is problem of coordination with test stations, the prototype assembly may be subject to water absorption test at manufacturer's works followed by live fire test which should be carried out at manufacturer's works in presence of Owner's representative. In line fire test, the temp. of furnace shall be of the order of 1000°C at the end of 3 hours. The test shall be carried out at atmospheric pressure.

g) Flame Resistance Test for fire Retardant Coating Material:

Sample strips shall be of ½ " wide, 12" long and approximately 70 mills in thick (without any reinforcement). Each strip shall be held vertically (clamped at the top) in a natural gas burner flame, (blue cone of flame touching bottom edge of sample) for 10 minutes. The flame shall then be removed and observation shall be recorded. In case, any flaming of the samples should cease after the removal of gas burner. White charred length of the sample should not exceed 1 & ½".

h) Anti-Rodent Test:

Physical tests:

a) This test shall be carried out to ascertain the anti-rodent properties of the components of the Fire proof sealing system.

b) This test shall be carried out at approved test station performing sealing system tests on pharmaceutical products. The complete Fire Proof sealing system shall be subjected to attack of inspect / vermin such as rate for about 20 days.

c) At the end of the test condition of the surface of Fire Proof sealing system the test material shall be compared with the surface condition before commencement of the test. The fire stop shall be deemed to have passed this test in case no marks of growth are seen on the surface.

3.6 All acceptance & routine tests as per relevant standards & specification shall be deemed to be included in the bid price.

3.7 Clause no. 7.1 (a) & (b) of section II may pls be read as:
a) Design, manufacture, testing at works, packing, supply, transportation to site of the fire sealing system materials.
b) Visual inspection & transportation of materials from site's storage yard to work site, handling, testing including supply and installation of all associated materials and consumables, carrying out of all associated minor civil works and furnishing of all skilled/unskilled labour and supervisory staff.

4.0 BILL OF QUANTITIES:

4.1 The bidder to quote for items as per 'BOQ-cum-Price Schedule' attached with NIT. The BOQ excludes civil works done in the opening and includes cross section area of cables and cable support materials within the area to be fire sealed.

4.2 Successful bidder shall submit calculations for supply of material based on area to be provided with fire sealing, cured density (based on type test certificate accepted by BHEL/ CUSTOMER) & thickness as applicable for the project, wastage, space occupied by cables, etc. for approval during contract stage.

For the first lot cleared by BHEL, the calculations shall be made based on the average of the minimum & maximum cured density (wherever a range is specified for the cured density by the manufacturer) & minimum thickness. For subsequent lots cleared by BHEL, the calculation shall be based on the cured density & thickness as per accepted type test results, duly adjusting the quantities cleared in earlier lot.

4.3 The bidder has to indicate that unit rates for conducting the type test successfully along with the offer, which will be considered for evaluation of tender.

4.4 Supplier to also give the following undertaking in the BOM:
"The BoM provided herewith completes the scope (in content and intent) of material Supply under PO No. ----------, dated ---------. Any additional material which may become necessary for the intended application of the supplied item(s)/package will be supplied free of cost in most reasonable time."

5.0 DRAWINGS & DOCUMENTS TO BE SUBMITTED

5.1 The following information shall be furnished with the bid:

a) Data Sheet-B.

b) Type test certificates for fire sealing system and cable coating material as mentioned in section-II.

c) Type test procedure

d) Typical drawings showing arrangement of various components and thickness etc.

e) Complete detail of the system

5.2 After placement of order, documents shall be submitted as per **NIT** for specific project requirement for BHEL & customer's approval.

5.3 Drawings/ documents shall be submitted through Document Management System (DMS).

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DATASHEET-A

1.0 REFERENCE CODES & STANDARDS

The latest edition of following standards shall be applicable:

a) ASTM-E-814: Standard test methods for fire test of Through-penetration fire stops.

b) ASTM E-119: Standard test methods for Fire resistance rating and hose stream test

c) IS-12458: Method of fire resistance test of fire stop

d) UL-1479: Standard test methods for Fire resistance rating

e) BS-476: Standard test methods for Fire resistance rating

f) IEC-60332-3-23: Flammability test for fire retardant coating

g) ASTMD-2863: Limiting oxygen index test for fire retardant coating

h) IS: 6005- Pretreatment shall conform to the requirement of IS: 6005.

i) IS: 2629- Galvanizing shall be done in accordance with IS: 2629.

2.0	Rating of fire stop	: Three (3) hours
3.0	Rating of Fire protection coating	: Thickness of coating compound shall be 2mm which shall be sufficient for achieving 30min fire rating.
4.0	Type of application	: Horizontal/ Vertical/ Below panels/ Across Trenches
5.0	Cable laying conditions	: Cables on cable trays
6.0	Suitability of fixing arrangement	: In masonry work/ In concrete work
7.0	Surface Treatment of Steel Material (for frame work as applicable)	
	a) Surface protection	: Galvanization conforming to IS:2629
	b) Mass of Zinc	: 460 g/m^2
8.0	Type of fire stop system	: 1) Fire stop system [Mortar based] 2) Fire retardant coating
9.0	Minimum shelf life of most perishable material	: 12 months
10.0	Life expectancy of material	: Greater than 40 years
11.0	Packing suitable for	: Storage on dry Surface

12.0 TYPE TEST

12.1 Successful bidder has to perform conduction of type tests on the offered material. Type tests on fire stop mortar seal & fire retardant coating for floor/wall opening/fire stop system for bottom of electrical switchgear MCCs/Panel are as under:

a) Water absorption test.
b) Vibration test.
c) Fire rating test.
d) Hose stream test.
e) Accelerated ageing test.
f) Temperature rise test for cables in fire stop
g) Anti-rodent test
h) Type tests for fire proof cable coating are as under:
   i) Flammability test (IEC-60332-3-32).
   ii) Limiting oxygen Index test (ASTMD-2863), limiting oxygen index of the material shall greater than 60%.

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DATASHEET-B/C
(Guaranteed technical Particulars to be submitted along with the bid)

1.0 GENERAL

1.1 Name of vendor : ……..

1.2 Address : ……

2.0 APPLICABLE STANDARDS

2.1 ASTM-E-814 & ASTM-E-119 For fire rating test and hose Stream test : YES / NO

2.2 IS-12458: Method of fire resistance test of fire stop : YES / NO

2.3 UL-1479: Standard test methods for Fire resistance rating : YES / NO

2.4 BS-476: Standard test methods for Fire resistance rating : YES / NO

2.5 IEC-60332-3-23: Flammability test for fire retardant coating : YES / NO

2.6 ASTMD-2863: Limiting oxygen index test for fire retardant coating : YES / NO

2.7 IS: 6005- Pretreatment shall conform to the requirement of IS: 6005 : YES / NO

2.8 IS: 2629- Galvanizing shall be done in accordance with IS: 2629 : YES / NO

3.0 TECHNICAL DETAILS

3.1 Type of system : 1) fire stop system Mortar Based [ ]
2) Fire retardant coating [ ]

3.2 Fire rating : 1) fire stop system ……
2) fire retardant coating ……

3.3 Pressure withstand capacity of Fire stop : ……. kg/mm^2

3.4 Weight of fire stop assembly (without cables) : ……. kg/mm^2

3.5 Shelf life of most perishable Material : ……. years

3.6 Life of total assembly : ……. Years

4.0 TYPE TEST

4.1 Successful bidder has to perform conduction of type tests on the offered material. Type tests on fire stop mortar seal & fire retardant coating for floor/wall opening/fire stop system for bottom of electrical switchgear MCCs/Panel are as under:

a) Water absorption test.
b) Vibration test.
c) Fire rating test.
d) Hose stream test.
e) Accelerated ageing test.
f) Temperature rise test for cables in fire stop
g) Anti-rodent test
h) Type tests for fire proof cable coating are as under:
   i) Flammability test (IEC-60332-3-32).
   ii) Limiting oxygen Index test (ASTMD-2863), limiting oxygen index of the material shall greater than 60%.

SECTION – II

STANDARD TECHNICAL REQUIREMENTS

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1.0 CODES AND STANDARDS

1.1 The material shall comply with all currently applicable safety codes and statutory regulations of India as well as of the locality where the material is to be installed.

1.2 The design, material, construction, manufacture, inspection, testing and performance of Fire Sealing System shall conform to the latest revision of relevant standards as per Data Sheet-A. Any other international standards will also be considered if it ensures performance equivalent or superior to standards listed.

1.3 In case of conflict between the applicable reference standard and this specification, this specification shall govern.

2.0 TECHNICAL REQUIREMENTS

2.1 Fire sealing system and fire retardant coating shall be supplied as per technical particulars specified in Data Sheet – A and Section-II.

2.2 **DESIGN REQUIREMENTS FOR FIRE STOP SYSTEM**

2.2.1 Type-B fire sealing system shall be of following system:

Mortar based sealing system

2.2.2 The fire stop system, in case of fire, shall prevent spreading of fire in cables/systems beyond the fire stops.

2.2.3 Cables shall be generally laid in cable trays/cable racks/ conduits and fire stop system shall be designed in such a way that the basic supporting structure of cables is not disturbed.

2.2.4 The system shall be retrofit design, physically and chemically stable.

2.2.5 Through penetration cable openings on floors and walls shall be divided into modules. Each module shall have spare capacity to accommodate additional cables in future. The fire stop system shall be designed to accept additional cables without impairing fire stop capability and without disturbance/ wastage of material in the nearby modules.

2.2.6 The system shall be mechanically secured to the masonry work/concrete work to resist dislocation.

2.2.7 The system shall remain unaffected due to any vibrations or expansion in cables. The system must also remain unaffected due to adverse temperature and humidity variations in the atmosphere. The system shall be suitable for ambient temperature of 50°C and relative humidity of 100%.

2.2.8 The system should be equally effective in horizontal & vertical formations.

2.2.9 The system should not affect the current carrying capacity of cables passing through the fire stop.

2.2.10 The system should provide firm grip on the outer surface of the cable in the event of fire.

2.2.11 The system shall be capable of withstanding mechanical loads, foot traffic, drop loads and wind pressure etc.

2.2.12 The fire stop system shall be completely gas & smoke tight.

2.2.13 Materials used for fire stop system shall meet the following requirements:

a) Should not get affected over a period of time due to humidity, moisture, ozone and variation in ambient temperature.

b) Should not contain volatile solvents after the setting period of system.

c) Should be able to withstand stresses due to expansion/ vibrations.

d) Should be free from shrinkage and cracking and should maintain smoke and gas tightness during fire.

e) Should not react with cable sheaths, galvanized and painted steel material etc.

f) Should be easy to apply/ install using conventional methods.

g) Should be non-toxic and harmless to the working personnel

h) Should have anti –rodent properties and should be repellent to pest & termites.

i) Should not produce any acid or alkali during gas generation.

j) Should not produce suffocating/ corrosive gas.

k) Should have a very low Expansion co-efficient, which is to be comparable with masonry concrete.

l) Should not be soluble and reactive to acid and alkali water.

m) Should have a low thermal conductivity.

n) The material in contact with the cables in the fire-proof sealing system shall be compatible with the material used for outer sheath of cables.

2.2.14 The system shall have a fire resistance rating of duration as per Data Sheet-A. Fire resistance rating shall be in accordance with ASTM E-119, ASTM E-814, BS-476, UL-1479 and integrity & stability shall be maintained by the system after application of water jet on the exposed side in order to extinguish fire.

2.3 DESIGN REQUIREMENTS FOR FIRE RETARDANT COATING

2.3.1 Materials used for fire retardant coating shall meet the following requirements:

a) Asbestos free, non-volatile, not eatable by vermin, harmless and non-irritant to skin of human.

b) Not affecting the current carrying capacity of the cables and the properties of the installed cables.

c) Coating material shall show no signs of cracking and peeling when the coated cable is bent to the radius of minimum sized cable at 180 degree C.

2.4 WELDING

a) All welded connections if applicable shall be made by electric arc welding. All welding work shall be carried out by qualified and experienced welders and adequately protecting the already laid cables.

b) All arc welding shall be carried out with low hydrogen content electrode.

c) All welded connection shall be allowed to cool down gradually to atmospheric temperature before putting any load on them. No artificial cooling should be adopted to cool welded joints.

2.5 **SURFACE TREATMENT**

2.5.1 Supply items:

Surface treatment of all material supplied shall be done as applicable in an approved manner and as per the specific requirements given in the Data Sheet-A. Surface treatment shall include following steps:

a) Pretreatment: Pretreatment shall conform to the requirements of IS: 6005.The clean and dry pretreated surface shall be given a coat of red oxide primer paint and shall be left for natural drying.

b) Galvanizing: Articles shall be hot dip galvanized after pretreatment. The galvanizing shall be done in accordance with IS: 2629. The galvanizing shall be uniform, clean, smooth, continuous and free from free acid spots. The amount of zinc deposit shall not be less than the value specified in Data Sheet-A.

2.5.2 After erection:

a) Galvanized items shall be given a surface treatment only at the welded joints and at the places where the galvanization has been damaged. Welded joints shall be applied with two coats of cold zinc paint whereas damaged portions of galvanizing shall be applied with single coat of zinc paint.

b) In addition to the above, the vendor shall ensure after completion of fire stop system that the final finish of all surfaces of materials is in good condition and wherever needed a touch up of cold zinc paint shall be given.

c) The final finish of all erected materials shall be uniform, clean, smooth and free from spots.

3.0 QUALITY ASSURANCE REQUIREMENTS

3.1 At contract stage, the successful bidder shall submit the Quality Plan in attached BHEL format for BHEL/ ultimate customer's approval. In case bidder has reference Quality Plan agreed with ultimate customer, same can be submitted for specific project after award of contract for BHEL/ ultimate customer's approval. There shall be no commercial implication to BHEL on account of minor changes in Quality Plan during contract stage.

3.2 Stages of quality control shall include but not be limited to the following:

a) Verification of test certificates for materials before dispatch.
b) Visual inspection of materials before dispatch (as applicable).
c) Testing of materials before dispatch.
d) Inspection of packing before dispatch.
e) Quality checks during erection.
f) Inspection & testing of fire stops after erection.

3.3 All materials shall be procured, manufactured, inspected and tested by vendor/ sub-vendor as per approved Quality Plan.

3.4 The supplier shall perform all tests necessary to ensure that the material and workmanship conform to the relevant standards and comply with the requirements of the specification.

3.5 In addition to meeting the type test requirements, material/ batch test certificates conducted at the premises of the bidder's principals for the supplies to be made for the project shall be submitted for BHEL/ CUSTOMER review and clearance.

3.6 All acceptance & routine tests as per relevant standards & specification shall be carried out. Charges for these shall be deemed to be included in the bid price.

3.7 Installation at site shall be as per parameters (i.e. minimum cured density & minimum thickness) achieved during type testing. In case type test waiver is given based on past type test certificates, installation shall be carried out as per the type test certificates accepted.

3.8 The successful bidder shall submit Field Quality Plan for storage, preservation, handling and erection work at site for fire-sealing system. The same shall subject to CUSTOMER/ BHEL approval without any commercial implications. Fire sealing shall be as per approved installation drawings.

4.0 TESTING

4.1 FIRE STOP SYSTEM

4.1.1 The system offered shall comply with the following type tests and test reports shall be submitted along with offer:
a) Accelerated aging test
b) Water absorption test
c) Fire rating test
d) Hose stream test
e) Vibration test followed by fire rating test

4.1.2 System shall be subjected to structural stability test, which shall be conducted at site.

4.2 FIRE RETARDANT COATING

It shall comply with the following tests and test reports shall be submitted along with offer:

a) Flammability test
b) Liming oxygen test

4.3 The test details have been covered in clause no. 5.0

4.4 System offered shall be **type tested** at **CBRI, Roorkee or by NABL accredited government approved Independent agency**.

a) The bidder shall furnish the reports of all the type tests for fire sealing system materials. These reports should be for the tests conducted on identical materials to those offered/ proposed to be supplied under the contract.

b) In case bidder is not able to submit report of type test(s) conducted or in case type test report(s) are not found to be meeting the specification/ relevant standard requirements, then all such tests under the contract shall be conducted free of cost to the owner, and reports shall be submitted for approval. No charges shall be paid under this contract.

4.5 Type Test charges:

a) In case type test certificates are available with vendor & acceptable to BHEL/ CUSTOMER and still vendor being asked to conduct type testing and type tests successfully conducted, the type test charges shall be payable to vendor at actual against Original money receipt of **CBRI Roorkee/ NABL accredited Govt approved lab.**

b) In case type test certificates are not available with the vendor or available with the vendor but not acceptable to BHEL/ CUSTOMER and vendor being asked to carry out type testing, and type testing successfully conducted, the type test charges by the vendor shall not be payable.

4.6 BHEL/ CUSTOMER reserve the right to witness type testing on any one lot for the project without any commercial implications.

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5.0 TEST DETAILS

5.1 FIRE STOP SYSTEM

5.1.1 Accelerated aging test:

The fire stop system specimen shall be subjected to accelerated ageing test for 168 hours. During the test, the system/ components shall be placed in air furnace where the temperature of inside air shall be maintained at 85 deg. C. The specimen shall be taken out of the furnace after 168 hours for water absorption test.

In case the mechanical properties before and after the accelerate aging do not indicate substantial change, the system shall be deemed to have passed the accelerated aging test. Similarly the variation in the form of the system/ component at the end of the test shall not indicate permanent deformation which is likely to affect the sealing properties of the system.

5.1.2 Water absorption test:

The test specimen shall be immersed in fresh clean water at a temperature of 20 $\pm$ 2 deg. C for a period of minimum 24 hrs. At the end of 24 hour soak period, the specimen shall be removed from water and mopped with a damp cloth. The specimen shall thereafter be subjected to the live fire test as per clause 5.1.3 below.

5.1.3 Fire rating test: shall be done as per ASTM E 814/BS: 476/UL: 1479/IS: 12458.

5.1.4 Hose stream test: Test shall be conducted on the test specimen immediately after fire resistance test as per ASTM E 119

5.1.5 Vibration test: The test specimen shall be subjected to vibration of 100Hz frequency and 0.5 mm amplitude for a minimum period of 3 hours.

5.1.6 Anti rodent Test

5.1.7 Temperature rise test for cables in fire stop

5.2 FLAME RETARDANT COATING

5.2.1 Flammability test shall be conducted in accordance with IEC-60332-I/ IEC-60332-3-23 CAT-B.

5.2.2 Limiting oxygen index test shall be conducted in accordance with ASTMD-2863. Limiting oxygen index of the material shall not be less than 35 %.

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6.0 APPLICATION OF FIRE SEALING SYSTEM & FIRE PROTECTIVE COATING ON CABLES WITH FIRE RESISTANCE COMPOUND SHALL BE AS UNDER:

6.1. FIRE SEALING SYSTEM

a) The various openings in the cable vault, vertical/horizontal raceways of cables penetrating walls/floors and the bottom of Electrical Switchgears and panels in Control Equipment room/MCCs/ Distribution Boards/Cabinets/Panels shall be provided with fire stop systems. Cables passing through the openings at various locations are laid on various tiers of the cable trays/racks in the bunch formation. In case, for the purpose of installation of seal system, steel frames are required to be fabricated and fixed in the openings, the fabrication of frame and fixing of the same shall have to be done by the Contractor. The necessary steel section for fabrication of frames shall be supplied by the Contractor without any extra cost. Any, civil works required to be done in the openings shall be carried out by the Contractor. Bidder shall also include one set of tools and accessories required for addition or removal of cables after the seal is made. This shall include special tools, compound injection guns, spray guns, etc.

b) All openings in the floor and wall for cable access shall be sealed after installation of the cable system with non-inflammable materials, as follows:
   i) Fire stop/ Penetration seal shall be installed in the cable spreaders and cable raceways.
   ii) For all H.T., L.T., relay and control panels, Control desk, instrumentation panels, battery charger, D.C. distribution boards and other miscellaneous panels, fire stops should be provided below base plate. The non-inflammable type sealing material shall be supplied by the contractor.

c) Except for inside an enclosure wherever the cable enters or leave the conduit, the conduit end shall be sealed by suitable sealing compound, having specified fire withstand capability.

6.2. FIRE PROTECTION COATING TO BE APPLIED ON INSTALLED CABLES: -

The cables shall be coated with fire protection material at the strategic locations as follows so as to limit the spread of fire:

a) At fire stops below electrical switchgear/ MCCs/ Panels/ cabinets etc. On one side coating for the specified rating. i.e. on the cable vault side/ cable trench side.

b) For the specified rating on adjacent/ one side(s) of the junction/ crossings of cabling work in open cable routes/ cable trench.

c) Fire coating shall be provided at an interval of 3 meters for a length of 1.5 meters in the straight portion of each of the cable trays above ground. At bends/ intersections and Tee joints, coating should be done 2 meters from centre line of cable tray on each side.

d) All vertical cables coming out below the panels shall be coated to a full length of vertical drop from bottom of panel plus 1.5 metres horizontal run after the bend.

e) Fire break shall be provided at an interval of 15 meters in cable trenches for a length of 3 meters.

f) In fire risk areas and where specified at suitable intervals at decided upon site conditions in open cable routes.

g) All Vertical cable runs anywhere in the area shall be coated full.

h) The coating shall be applied evenly on the cables only.

7.0 PRICES

7.1 Unit prices listed out in this clause shall be applicable for payment to the vendor for activities covered under this specification. The Unit prices shall be inclusive of:

a) Design, manufacture, testing at works, packing, supply, transportation to site, handling at site of the fire stop system materials.

b) Visual inspection & transportation of materials from vendor's/owner's storage yard to work site, handling , testing including supply and installation of all associated materials and consumables, carrying out of all associated minor civil works and furnishing of all skilled/unskilled labour and supervisory staff.

c) Provision of fasteners like nuts, bolts, washers, spring washers, rawl plugs, anchoring bolts and lugs etc.

d) Provision of all sealing compounds for wall and floor openings.

e) Consumables like enamels, cold zinc paint, electrodes for welding etc.

f) Minor civil works like chipping/breaking of floors/walls and masonry work for reducing/closing of openings on floor/walls including supply of materials like cement, sand, bricks etc. as required. Any work as described above to the extent of 200 mm on all sides of openings on walls and floors for the purpose of fitting the actual fire stop assembly shall be deemed to have been included in the unit prices of fire stop assembly.

g) Provision of all facilities/equipment for all site fabrication such as cutting, bending and drilling equipment.

h) Provision of welding sets.

i) Provision of special tools and tackles for erection.

j) Provision of all testing equipment and conducting the specified test after erection at site.

7.2 Requirement of Quality Plan and Field Quality Plan shall be considered in the quoted prices.

8.0 MEASUREMENT & WASTAGES

8.1 Quantity measurement: For all payment purpose, measurement shall be made on the basis of the execution drawings/physical measurements. Physical measurements shall be made by vendors in the presence of Engineer.

8.2 Wastage Allowance: No wastage allowance is permissible. All wastages shall be to the account of vendor.

9.0 ADDITIONAL POINTS OF CONSIDERATION

9.1 Bidder shall be deemed to have confirmed to the specification in toto.

9.2 All work shall be carried out in accordance with the agreed field quality plan and approved drawings. The field quality plan shall additionally specify the fire sealing material thickness, minimum cured density and other related parameters achieved in the approved type tests for the contract. The work shall be done to the satisfaction of purchaser and acceptance of the work shall be subject to the purchaser's approval.

9.3 The work to be carried out under this specification shall be done under the supervision of purchaser's/owner's representative.

9.4 The installation work at site shall be properly coordinated with other services.

9.5 All materials, equipment, instrument, hardware, tools, consumables, fasteners, accessories whether specifically mentioned or not in offer required for complete installation and testing in all respect and to the satisfaction of Engineers will be in the scope of vendor and no extra payment will be made for the same.

9.6 All materials being supplied or consumed during erection by the vendor in the process of erection work shall be of best quality and according to the relevant standard. All materials shall be got inspected and got approved by the Engineer before the same is used for erection. Also, purchaser reserves the right to carry out inspection of installation work at any stage during erection, testing and commissioning.

9.7 Any drilling and welding on building structural steel for fixing supports etc. will not be done without the prior written approval of Engineer.

9.8 Any work like chipping, or breaking of existing structure like walls, floors, fabrication etc. shall be done after taking prior approval of Engineer.

a) After installation of fire stops through a structure, the vendor shall repair/ refabricate the affected portion of structure.
b) Any wrong erection shall be removed and re-erected promptly to comply with requirement at no extra cost.

9.9 After completion of work the contractor shall remove all debris and Take back all erection implements, left - overs, surplus materials over and above the ordered quantity without any financial implications to either party.

10.0 PERFORMANCE GUARANTEE

Bidder shall guarantee that the system offered shall meet the requirements as indicated in this specification and as confirmed through various clauses of datasheets. If it is proved that the system doesn’t conform to performance guarantee, the bidder should be ready to replace the faulty components/ equipment without any loss or extra cost to the purchaser.

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11.0 PACKING & STORAGE

All material/ components of fire stop shall be supplied in proper packing to avoid contamination of material due to dust/ moisture. All packing shall be of durable quality. Space shall be provided by BHEL. Packing containers shall be suitable for storing on dry surface.

FORMAT FOR QUALITY PLAN

	QUALITY PLAN	CUSTOMER		PROJECT TITLE		SPECIFICATION : NUMBER :						
		BIDDER/ :		QUALITY PLAN NUMBER		SPECIFICATION TITLE						
		VENDOR										
	SHEET 1 OF 1	SYSTEM		ITEM :FIRE STOP MATERIAL		SECTION	VOLUME III					
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10	10	10	11

LEGEND : P : PERFORMER W: WITNESSER V: VERIFIER 1- BHEL 2-VENDOR 3- SUB VENDOR CHP: CUSTOMER HOLD POINT WHICH WILL BE DECIDED AT CONTRACT STAGE.

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

ANNEXURE-1

INSTRUCTIONS FOR QUALITY PLAN

The Quality Plan shall include all the Quality Control Measures and Checks adopted by the Vendor to ensure that the material/component/assembly/services supplied by him meet/will meet the requirements as per specifications and good practices. They shall include all stages of operation such as materials, processes, manufacture, assembly, packing and despatch. The following guide lines may be noted:

Column 1- Serial Number

Column 2- Component/Operation- The component and/or operation being checked shall be given here.

Column 3- Characteristics check- The characteristics being checked shall be given here, e.g., chemical composition, mechanical properties, leak tightness, surface defects etc..

Column 4- Category -'CR' stands for critical characteristic - affecting safety of equipment and personnel

'MA' stands for major Characteristic - affecting safety of equipment and personnel

'MI' stands for minor characteristic - affecting appearance etc.

Column 5- Type/Method of check e.g. chemical analysis tensile testing, hydraulic test, visual examination radiography etc.

Column 6- Extent of check, such as, 100, 10, 1 percent etc.

Column 7- Reference Documents - Documents, such as technical specification, drawings, standard specifications (IS, BS ETC.) procedure, etc. according to which check is done.

Column 8- Acceptance Norms - Standards etc. according to which acceptability or otherwise of the characteristics being checked is decided.

Column 9- Format of Record - Formats, log shets, reports, etc. in which the observations are recorded. Standard log sheets, reports, formats etc. of the Vendors shall be numbered and such reference numbers shall be included here.

Column 10- Agency - The agency which performs the test/instruction shall be written in sub-column 'W'
The agency which verifies test certificates/inspection records and carries out audit check of the components/operation shall be written in sub-column 'V'

The agencies are codified as 1,2 & 3

'1' stands for (BHEL)

'1' * means the operation shall be cleared by BHEL before the start of the next operation.

'2' Stands for Vendor

'3' stands for sub-Vendor of the Vendor and so on.

Example :

Entry '3' in column 'P' means test./inspection to be performed by sub-Vendor's QC

Entry '2' in column 'W' means test./inspection to be witnessed by Vendor's QC

Entry '1' in column 'V' means verification shall be done by BHEL and next stage to be started only after the hold point is cleared by BHEL

Column11I- Remarks - Any special remarks shall be given here.

NOTES :

1. In absence of correlation with the test certificate(s) (e.g. material identification) samples shall be drawn bgy BHEL and all tests as per relevent specifications shall be carried out in their presence or in recognized Government Laboratory.
2. When materials and components are initially identified and stamped by BHEL QS engineer, the identification marks shall be presserved till despatch. Wherever this is not possible, the identification mark shall be transferred to the components in the presence of BHEL QS Engineer unless other wise agreed.
3. For castings and forgings integral test specimens shall be provided, When this is not possible for casting, they shall be poured in the presence of BHEL QS Engineer unless otherwise, if witnessing of test by BHEL is called for.
4. When welders qualified by reputed inspection agencies or statutory bodies are not available, qualification tests shall be conducted in the presence of BHEL QS Engineer.
5. This Quality Plan is liable to be modified as per the requirements of approved drawings and changes in technical specifications/drawings. If there are contradictions in respect of column 7 & 8 between this Quality Plan and the approved drawings specifications, the latter shall prevail.
6. Wherever inspection by BHELs Purchaser/Third Party/Statutory authorities are mandatory, this shall be compiled with.
7. Inspection reports, log sheets, test reports/certificate. etc. shall be furnished to BHEL at the approproate stages or at the time of final inspection, as required.
8. This Quality Plan is also applicable to spares, if any, under scope of supply of Vendor.
9. The quality plan shall be submitted in minimum 4 copies with a soft copy of the same or in line with contract requirements.