Presenter Name: BASANTA KUMAR SINHAMAHAPATRA
Paper name: **Development of a New Refractory Repair Technology in Hot Blast Stove in pressurized condition at SAIL-IISCO Steel Plant**

PRESENT AFFILIATION	**SAIL-IISCO STEEL PLANT**
AREAS OF INTEREST	**PERFORMANCE OF CERAMICS**
Education	**B TECH (CERAMIC)**

Experience	**PRODUCT DEVELOPMENT, REFRACTORY MAINTENANCE IN STEEL PLANT, PROJECT MANAGEMENT, ERECTION AND COMMISSIONING , PLANNING & PROCUREMENT OF REFRACTORY MATERIALS, TROUBLE SHOOTING AND PROBLEM SOLVING IN REFRACTORY DESIGN AND APPLICATION**
Projects:	
Publication/ Patent	1. Microstructure of refractory castables prepared with sol-gel additives. *Ceramics International, Volume 29, Issue 6, 2003, Pages 671-677.* 2. Insitu spinel bonded refractory castable in relation to co-precipitation and sol-gel derived spinel-forming agents. *Ceramics International, Volume 29, Issue 8, 2003, Pages 857-868*.

Development of a New Refractory Repair Technology in Hot Blast Stove in pressurized condition at SAIL-IISCO Steel Plant

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INTRODUCTION

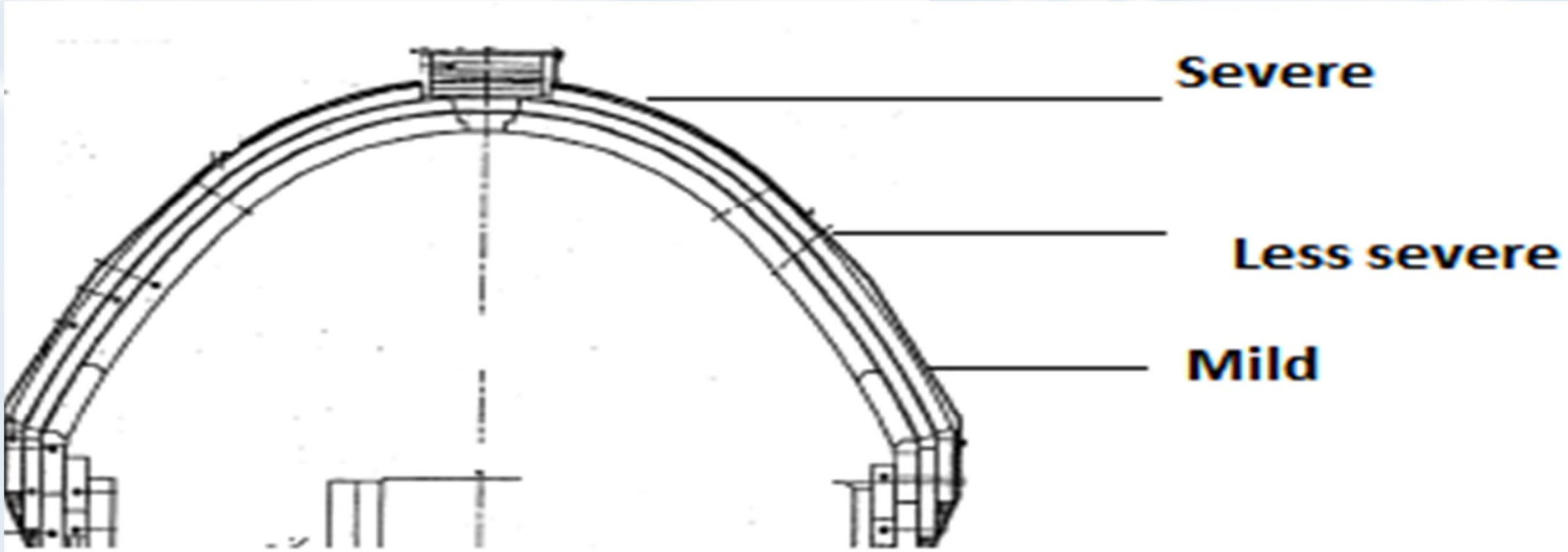
SAIL-ISP has single blast furnace of volume 4160 m3 with following provisions for hot blast:

Nos. of operating stoves		3
Operating mode		Standard operation 2 on gas / 1 on blast, cyclic
Maximum dome temperature	:	1450° C (Operating)
Maximum hot blast temperature	:	1250°C (Max), 1200°C (avg.)
Cold blast pressure at blower outlet	:	5.2 Kg/Cm2(g)
Blast Pressure at bustle pipe	:	4.6 Kg/cm2 (Max.)
Cold blast temperature	:	180° C, 240 ° C (Max.)
Shell Total Heights :	:	48 m
Checker refractory total Heights :	:	37.5 m

INTRODUCTION

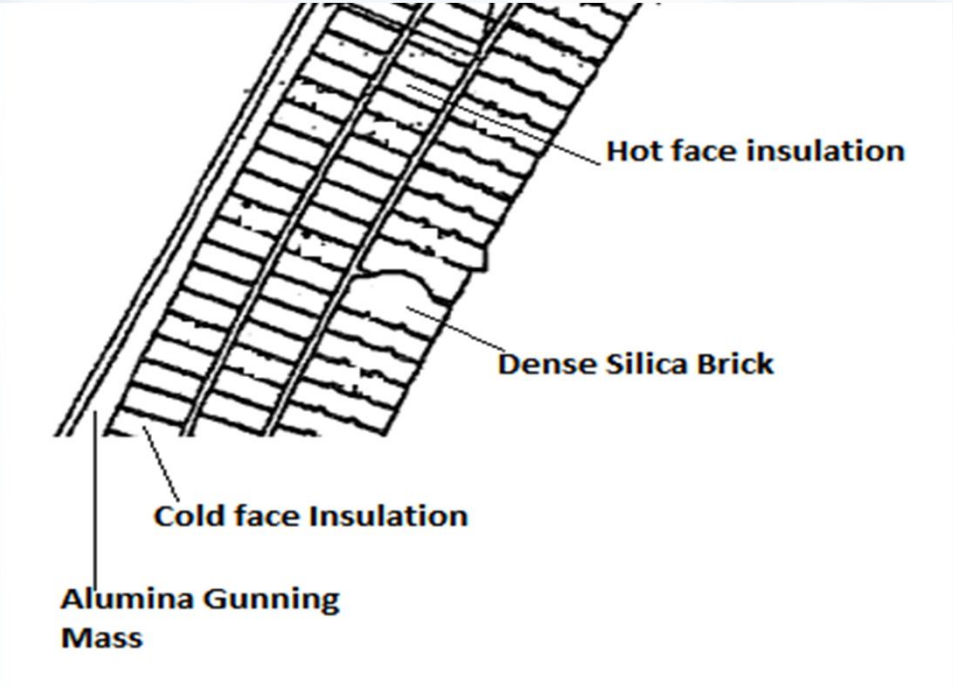
- The stove were commissioned in November, 2014 along with the furnace,
- Within 4 years of operations, development of hot spots on shell of stove dome started. Nos. of hot spots gradually increased with the passage of time and domes of all the stoves, hot blast main and bustle main were affected.
- Shell temperature of stove#1 crossed 400 °c and water spray was introduced to cool the shell.
- Repair by injection done by the OEM in January 2020 and August 2021 but hot spots appeared again after 4 to 5 months and water spray on shell was restarted. Prolonged water spray was affecting the shell. Cost and timely availability of the service by OEM is not favourable.
- A repair technique has been developed by ISP using materials, machines and tools make in India. Repair by injection was carried out in June 2022.

LOCATION AND SEVERITY OF HOT SPOTS IN DOME AREA

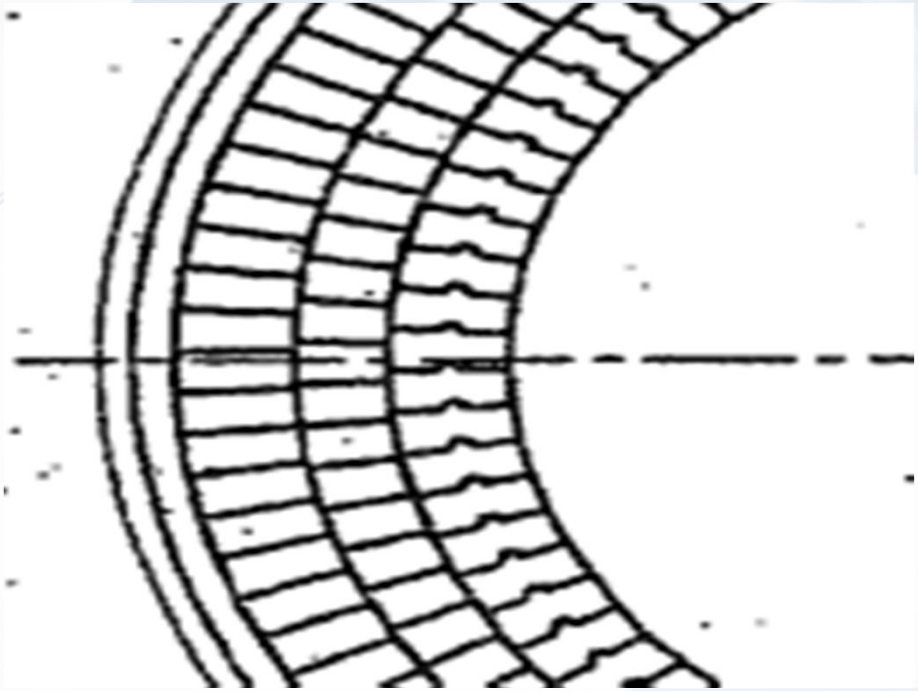


REFRACTORY LINING PATTERN

DOME



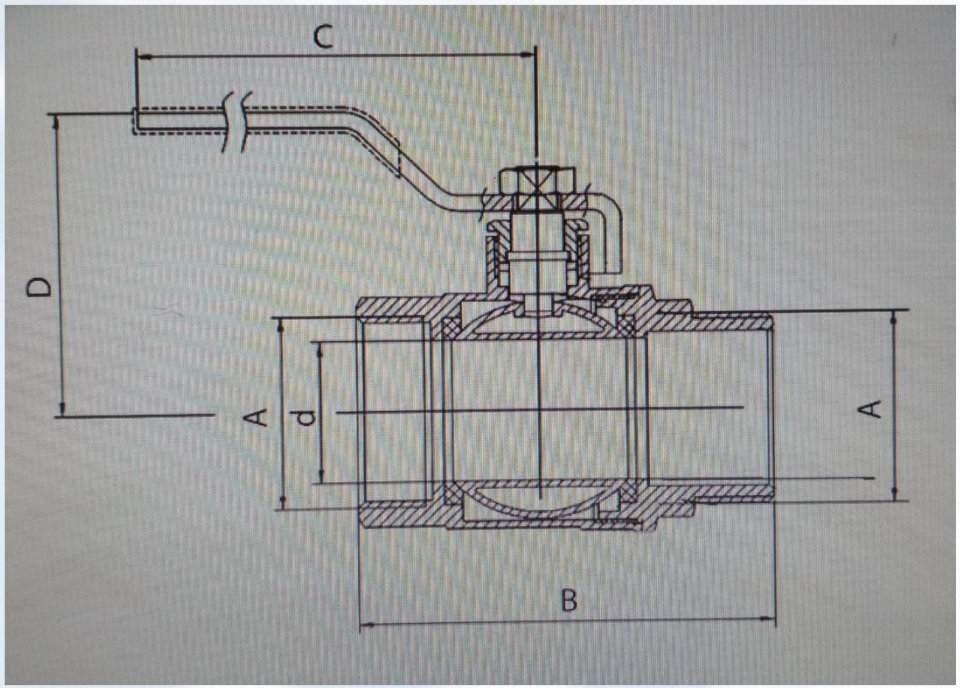
HOT BLAST MAIN



DIFFICULTY TO CARRYOUT REPAIR IN DOME AREAS

- During shut down of the blast furnace, repair of the HBM and BM areas were carried out by cutting of shell or injection of mortars by welding nozzles on the shell by conventional repair methods. Draft created in Back-draft chimney ensures negative pressure in these areas.
- But at the dome, very difficult to create sufficient draft because of quite high temperature inside stoves compared to chimney.
- Hot gas comes out if any opening is created in the dome area.

USE OF VALVE ALONG WITH THE NOZZLE TO STOP COMING OUT OF HOT GAS



SELECTION OF REFRACTORY MATERIAL

Properties

Major Components	**Alumina (%)**	**45**
	Silica (%)	50
Solid content	(wt%)	40
Density (Dry)	g/cc	0.52
Classification temperature	°c	1400

Performance parameters

- Insulating
- Ability to flow and penetrate through narrow gaps.
- Development of strength after installation
- Temperature resistance

OFF-LINE TEST

Surface of the brick structure

Inside the brick structure

DRILLING AND TAPPING THE SHELL

DRILLING

TAPPING

PUMPING OF REFRACTORY

PUMP

Process

- Nozzles and valves fixed by partial drilling and tapping of the shell
- Final drilling done through the valve
- Pumping done at 4 to 5 kg/cm2 pressure
- After pumping, valve removed and nozzles were capped.

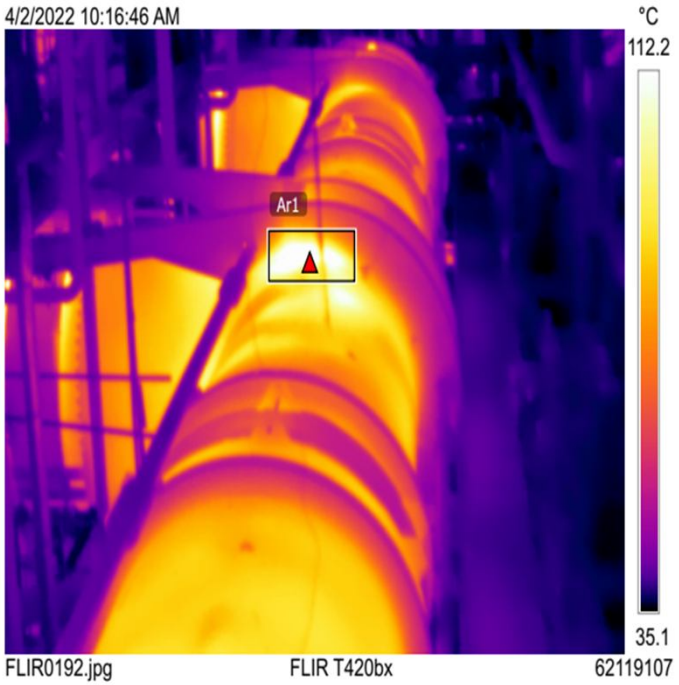
COMPARATIVE THERMOGRAPHY OF HOT BLAST MAIN AREA

Before Injection

Measurements		°C
Ar1	Max	131.3

Parameters	
Emissivity	0.95
Refl. temp.	20 °C

Geolocation	
Compass	S

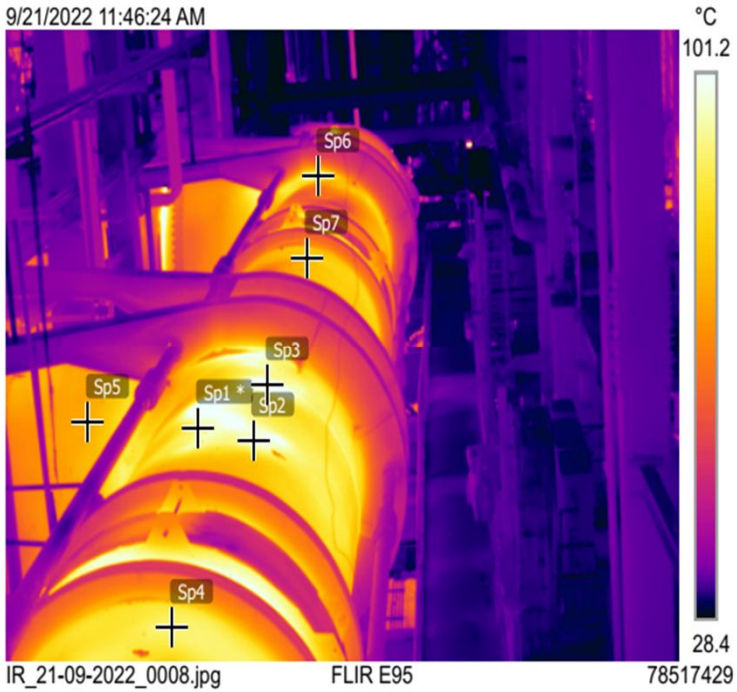


After Injection

Measurements	
Sp1 *	95.2 °C
Sp2	98.7 °C
Sp3	109.1 °C
Sp4	92.7 °C
Sp5	76.6 °C
Sp6	101.6 °C
Sp7	82.5 °C

Parameters	
Emissivity	0.98
Refl. temp.	20 °C

Note
Hbm



THERMOGRAPH OF A HOT SPOT AT STOVE#1 DOME

Before Injection

Measurements	
Sp1	184.9 °C
Sp2	185.9 °C
Sp3	186.7 °C
Sp4	184.3 °C
Sp5	163.9 °C
Sp6	172.7 °C
Sp7	156.6 °C
Sp8	173.7 °C

Parameters	
Emissivity	0.98
Refl. temp.	20 °C

Geolocation	
Location	N 23° 40' 3.20", E 86° 55' 3.41"

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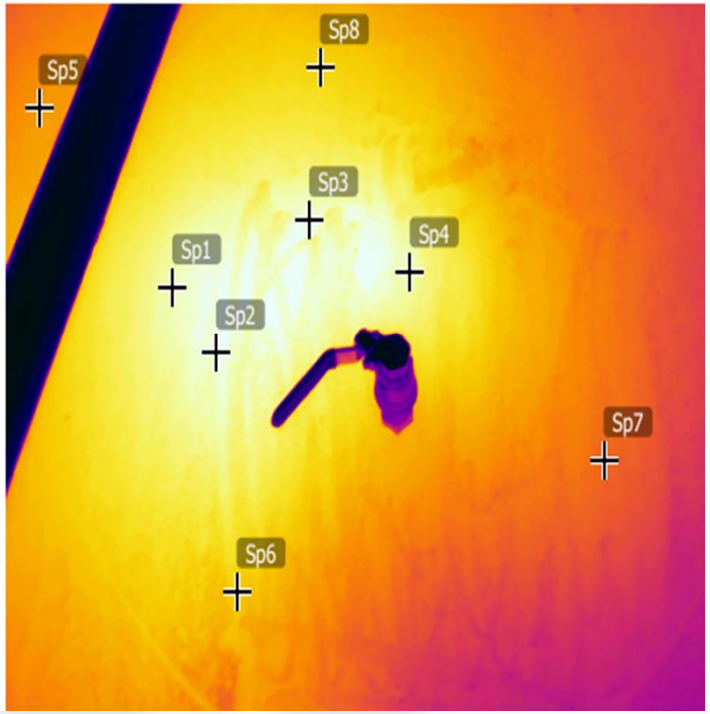

After Injection

Measurements	
Sp1	94.5 °C
Sp2	92.5 °C
Sp3	91.2 °C
Sp4	94.9 °C
Sp5	95.7 °C
Sp6	98.6 °C
Sp7	98.8 °C

Parameters	
Emissivity	0.98
Refl. temp.	20 °C

Geolocation	
Location	N 23° 40' 3.13", E 86° 55' 3.08"

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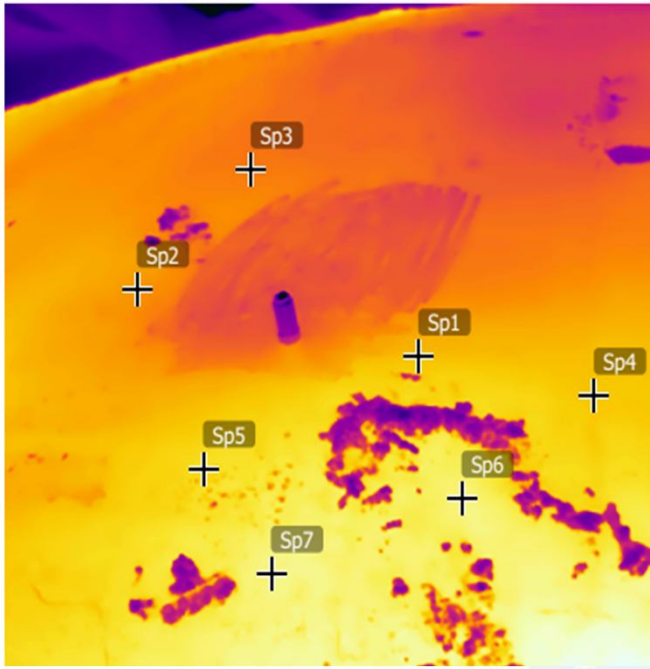
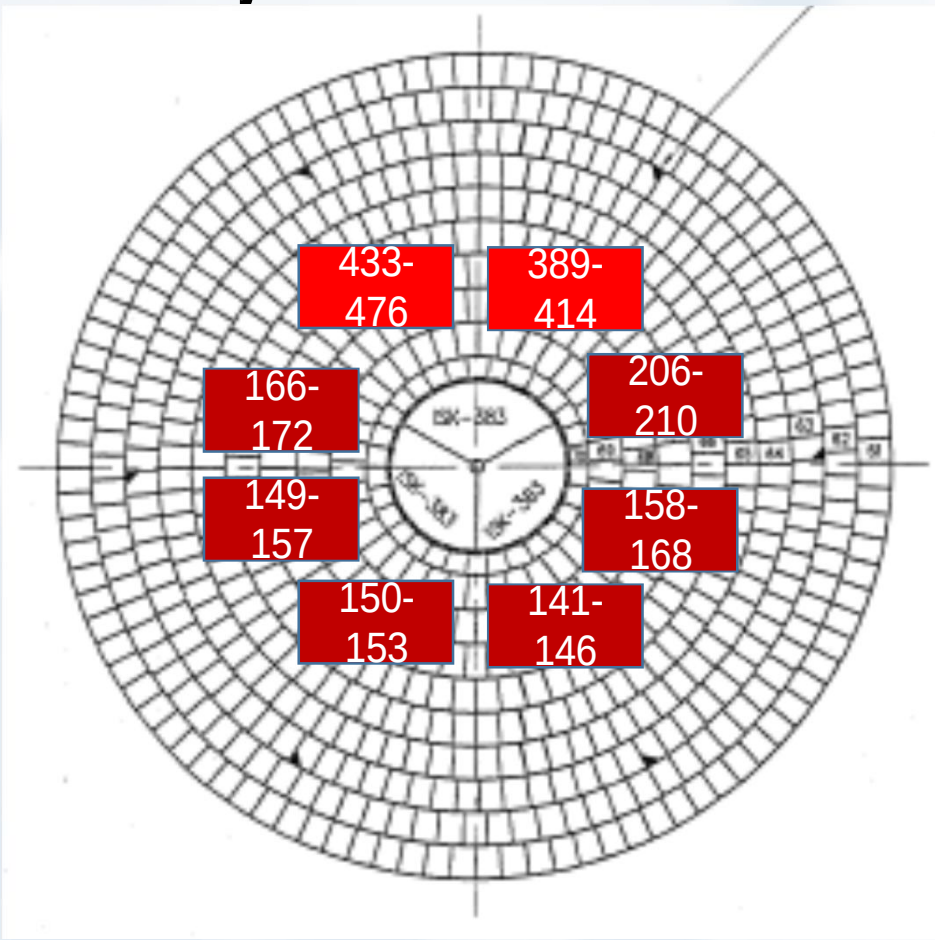
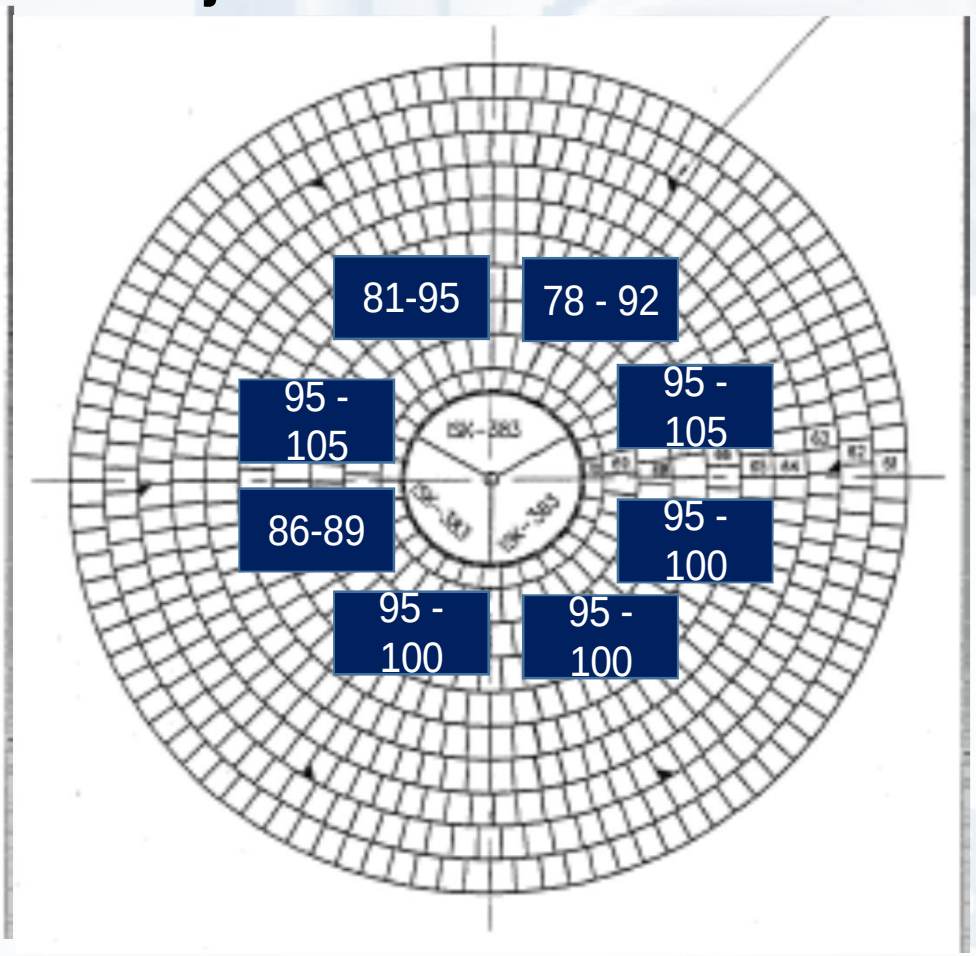


SHELL TEMPERATURES ON HOT SPOTS AT SEVERE ZONE OF STOVE#1 DOME

Before Injection



After Injection



INFERENCE

- **Defects in the insulation layers of the hot blast system of a blast furnace can be successfully repaired using ceramic fiber based pumpable refractory.**
- **The technology developed at SAIL-ISP can be used for online repair of hot blast stove without isolating the stove or taking shut down.**
- **The above technology ensures safety of the workmen from injury by hot gas/steam which may come out if the vessel have higher than atmospheric pressure. Coming out of hot gas or steam can be controlled or stopped by closing the valve as and when required.**
- **This is a low cost but effective Make in India solution with less lead time for implementation.**

THANK YOU!