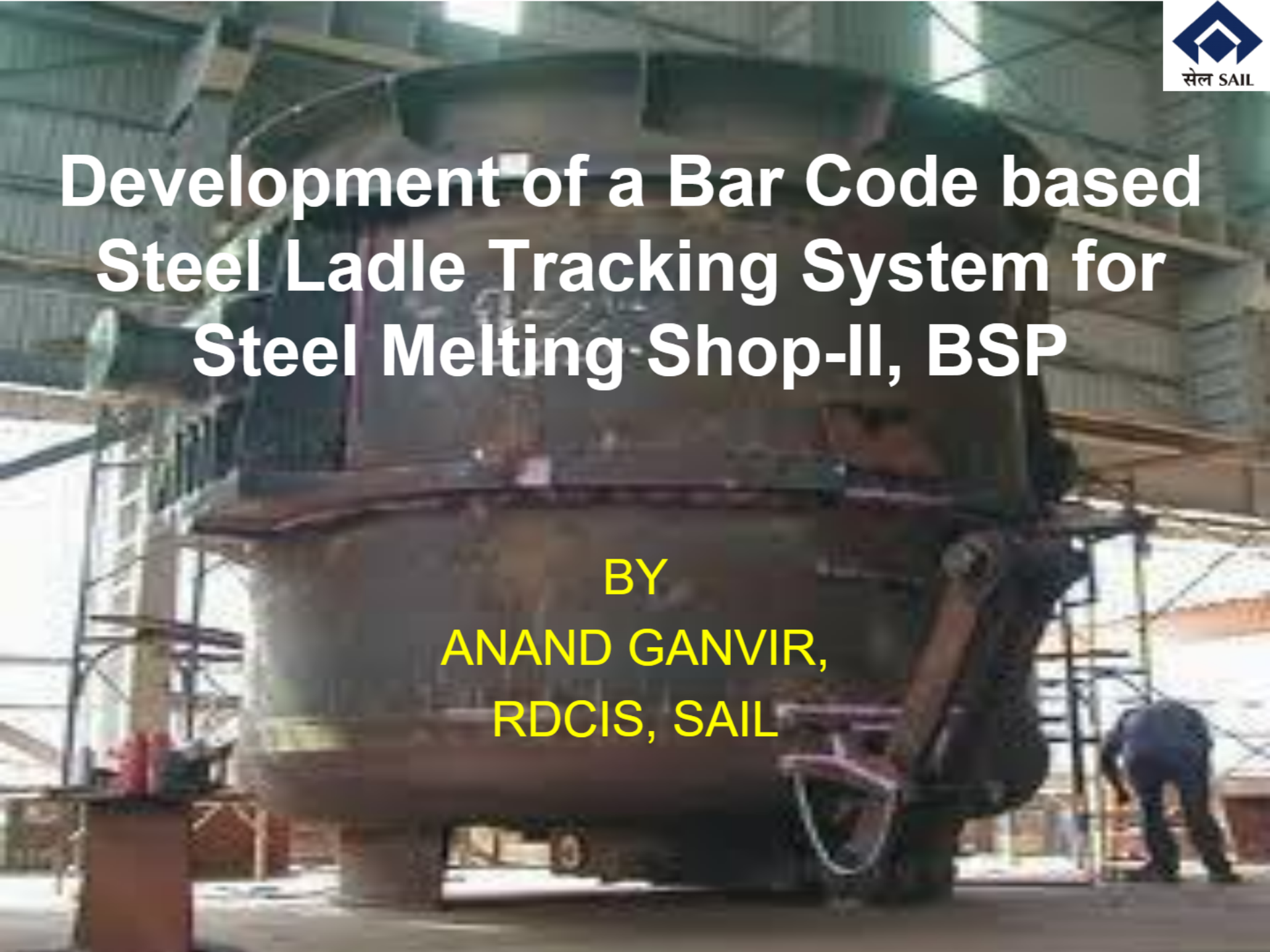


Development of a Bar Code based Steel Ladle Tracking System for Steel Melting Shop-II, BSP

BY

ANAND GANVIR,

RDCIS, SAIL

Why is Ladle Tracking Required?

- Excessive No of Ladles under circulation.
- Wide variation in ladle circulation time.
- Aberrations in pre-planned ladle circuit.
- Introduction of return heats back into ladle circulation.
- Ladle as well as thermal tracking.

Ladle Tracking-Benefits

- Optimizes the total number of ladle required to be in circulation under different circumstances.

- Scheduling and Planning of ladle movement and its maintenance w.r.t shop productivity.

- Back calculation/prediction of tap temperature and temperature drop during tapping/movement/processing.

- Decrease the number of return heat from CC due to inadequate temperature.

- Develop a Computerized Management Information System (MIS) for ladle status and failure analysis.

Ladle Tracking and Ladle Data -Features

- Schematic view of the ladle circuit with a map like view of positions of ladles in the steel shop.
- Ladle life and condition.
- Time duration at various points like SSM start/end, ladle preparation start/end are captured and displayed.
- ladle history :Status, location, last cast end, tap start, reference details in relation to parameters like heat no, date etc are stored and can be retrieved conveniently.

Tracking Methodologies

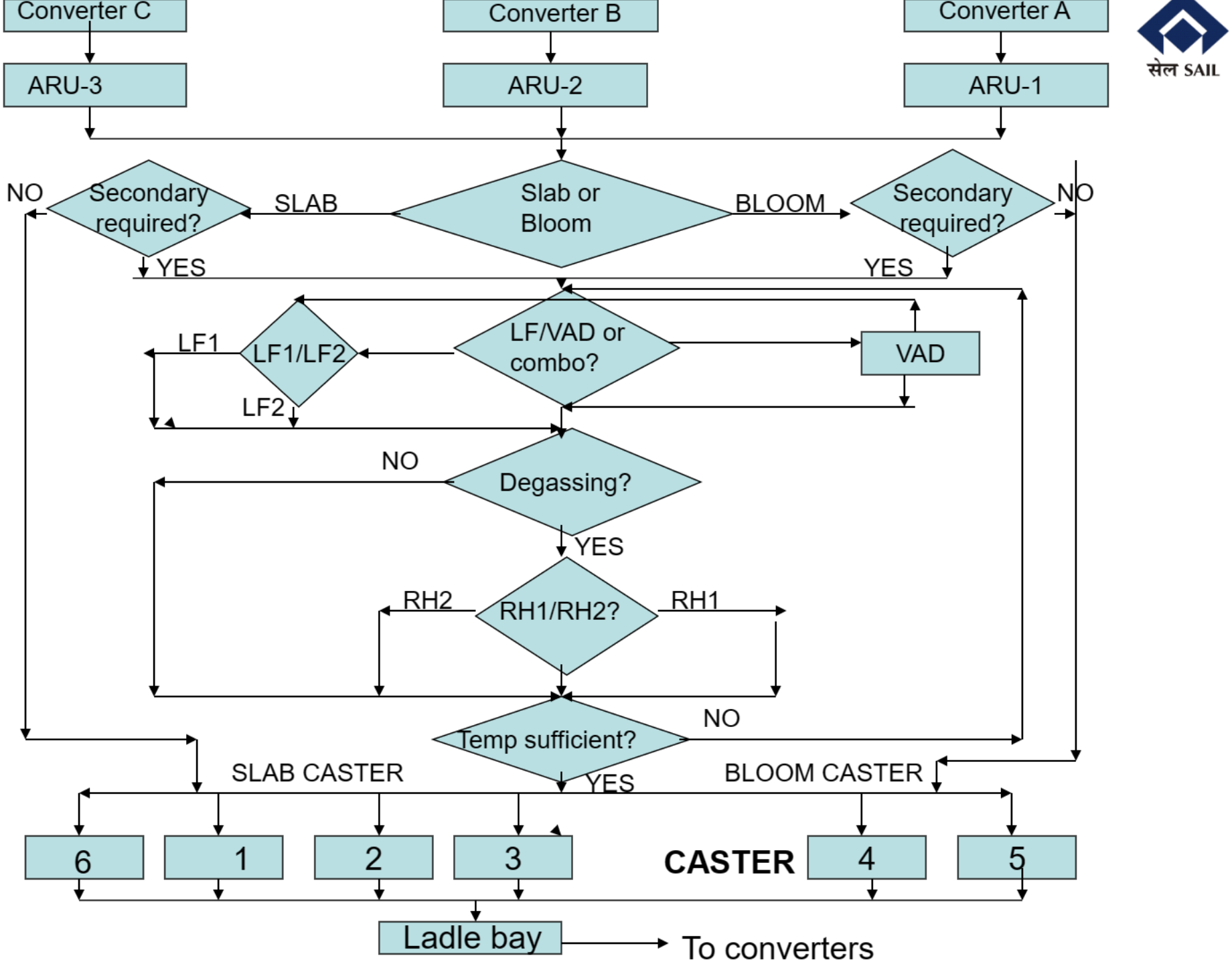
- GPS-global positioning system: used in BF ladles/torpedo car.
- RFID-radio frequency ID.
- Camera based visual tracking.
- Optical image processing.

BSP SMS-II :-AN OVERVIEW

- Annual production :2.8MT
- Facilities available:

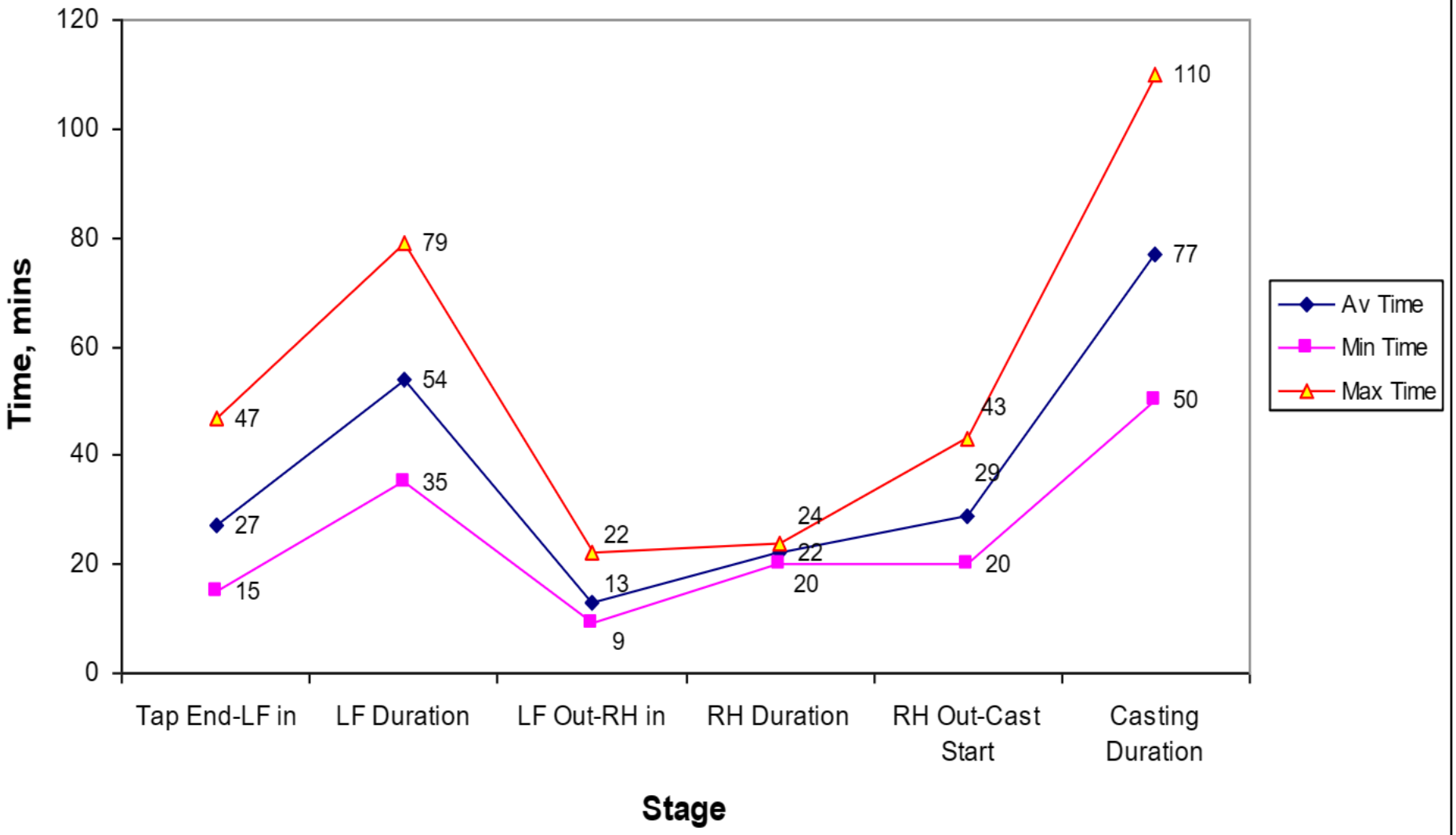
  BOF : 3 no
  ARU : 3 no
  LF : 2 no
  RH : 2 no
  VAD : 1 no
  CC : 6 no

- Average no of heats/day : 65
- Total No of steel ladles : 32
- Maximum 15 ladles are in circulation at a time.
- Minimum 5 ladles are in circulation (in case of direct heats).
- Average casting end to tapping time is around 90mins.
- Average life cycle of a ladle in circulation is 4.5hrs.


Converter C
Converter B
Converter A
ARU-3
ARU-2
ARU-1
NO
Secondary required?
SLAB
Slab or Bloom
BLOOM
Secondary required?
NO
YES
YES
LF1
LF1/LF2
LF2
LF/VAD or combo?
VAD
NO
Degassing?
YES
RH2
RH1/RH2?
RH1
NO
Temp sufficient?
YES
SLAB CASTER
BLOOM CASTER
6
1
2
3
CASTER
4
5
Ladle bay
To converters

Typical Ladle Routes

- BOF-ARU-LF-RH-BLOOM CASTER
- BOF-ARU-VAD-RH-BLOOM CASTER
- BOF-ARU-LF-RH-SLAB CASTER
- BOF-ARU-LF-SLAB CASTER
- BOF-ARU-VAD-SLAB CASTER
- BOF-ARU-SLAB CASTER



Time –Motion analysis

Requirements from LTS

a) Ladle ID.

b) Date and time stamp of tracking.

c) Development of MIS package for various stages of SMS-II process where the ladle tracking is required.

Ladle Tracking Philosophy

SENSORS:

- **Unique Identification Number.**
- **Read from all possible orientation.**

  (0^0-180^0C)
- **Present on both sides of ladle.**
- **Passive in nature.**
- **Temperature tolerant on cyclic use basis.**

  (ladle surface temperature ≈400^0C)

Bar Code Tag

- **Substrate:** anoidised aluminium.
- **Topcoat:** teflon coating.
- **Working temp:**
  <400C (cyclic use)
  <600C(short duration)

Reader:

- Should be Wi-Fi.
- Can be hand held or fixed.
- Should have visual display.
- Should be rugged and simple to handle.
- Connected to server at main control room via wire.

Wireless Infrastructure

- Should have sufficient number of access points.
- Access points should be capable of covering multiple sensors and should work on open technology platform.
- Tracking data should be stored in server phase wise and easily identifiable by means of basic identified parameters like heat No, Grade, Ladle No.

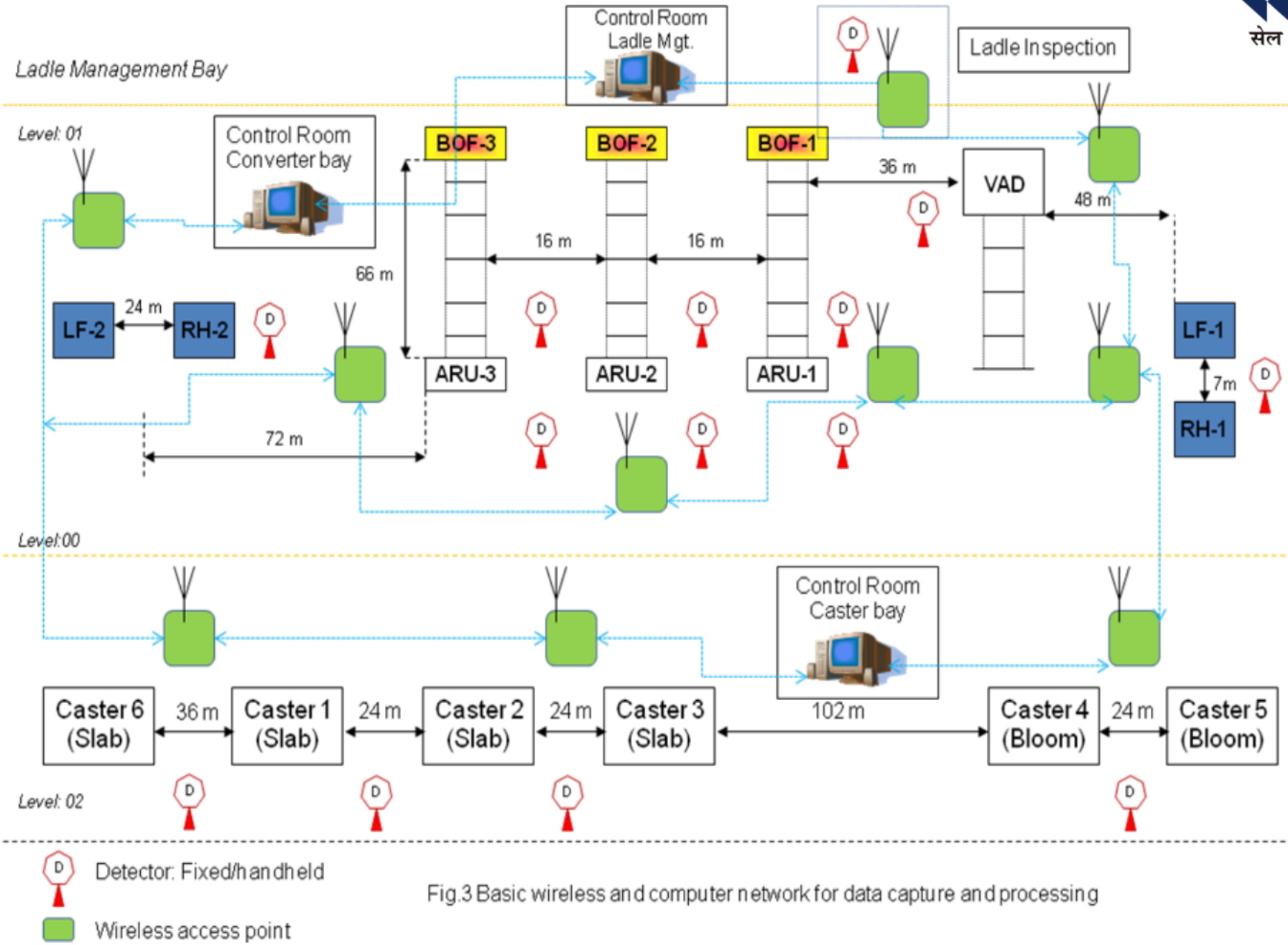


Fig.3 Basic wireless and computer network for data capture and processing

LADLE TRACKER

Steel Melting Shop-II, Bhilai Steel Plant

Steel Authority of India Ltd.

Date	dd/mm/yyyy	Tap time	hh:mm	Next tap time	hh:mm	Heat no.	xxxxxxxx	Grade	xxxx

Ladle nos.	0~32	Ladle life	Ladle Loc.	
	028	80	ARU#3	
	016	22	CC#5	
	023	68	LF#2	
	008	33	Relining	
	017	02	reheating	
	012	56	Pren. bay	

Date & time of arrival

Exptd. time of release

Exptd. date & time to be ready for
-Circulation
-Tapping etc.

- Fields to be inputted manually: Tap time, Next tap time, Heat no., Grade
- Ladle life shall be incremented by 1 manually, when offered for tapping after inspection at Ladle bay
- Fields to be filled automatically through LTS: Ladle nos., Ladle location, Drop down display box

Fig: MIS Interface

Trials and Observations

Trial:

- 2 tags(8” X12’’) were attached to ladle No 15 and 3.

Observations:

- Tags completed >50 ladle cycles without any damage.

- The range of tags is around 11ft which caused a restriction.

Future course of action

- Explore to enhance the durability and scope of tag based tracking by following:
  - Material of the tag.
  - Dimension of the tag.
  - Automation of the reading process.
  - Reliability of continuous data transfer.
- Combine with other tracking systems for maximum effectiveness/accuracy.


THANK YOU