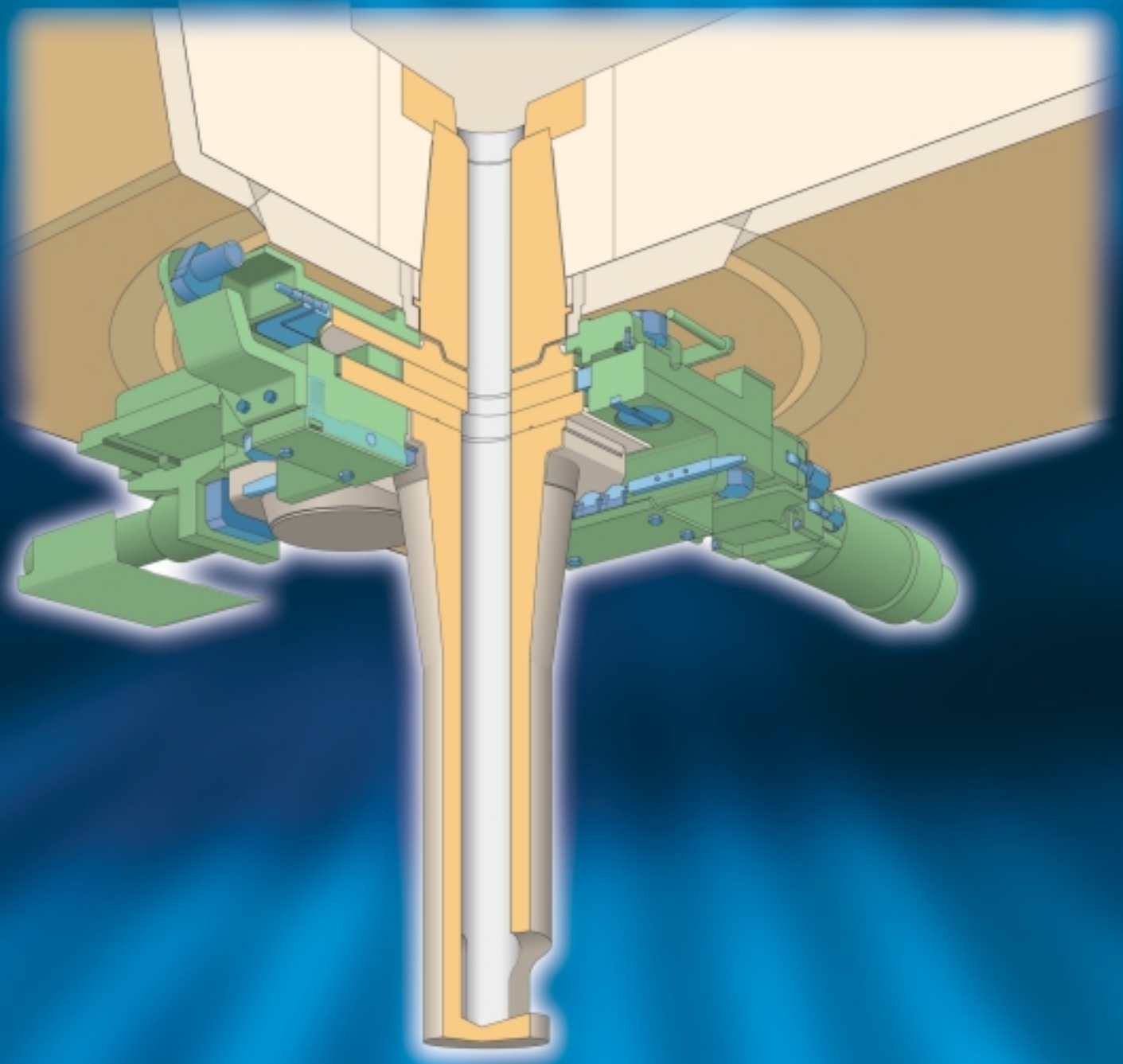


# Operation of a 3-plate tundish gate for slab casters with non-stop submerged nozzle change at ISPAT Mexicana in Lázaro Cárdenas, Mexico



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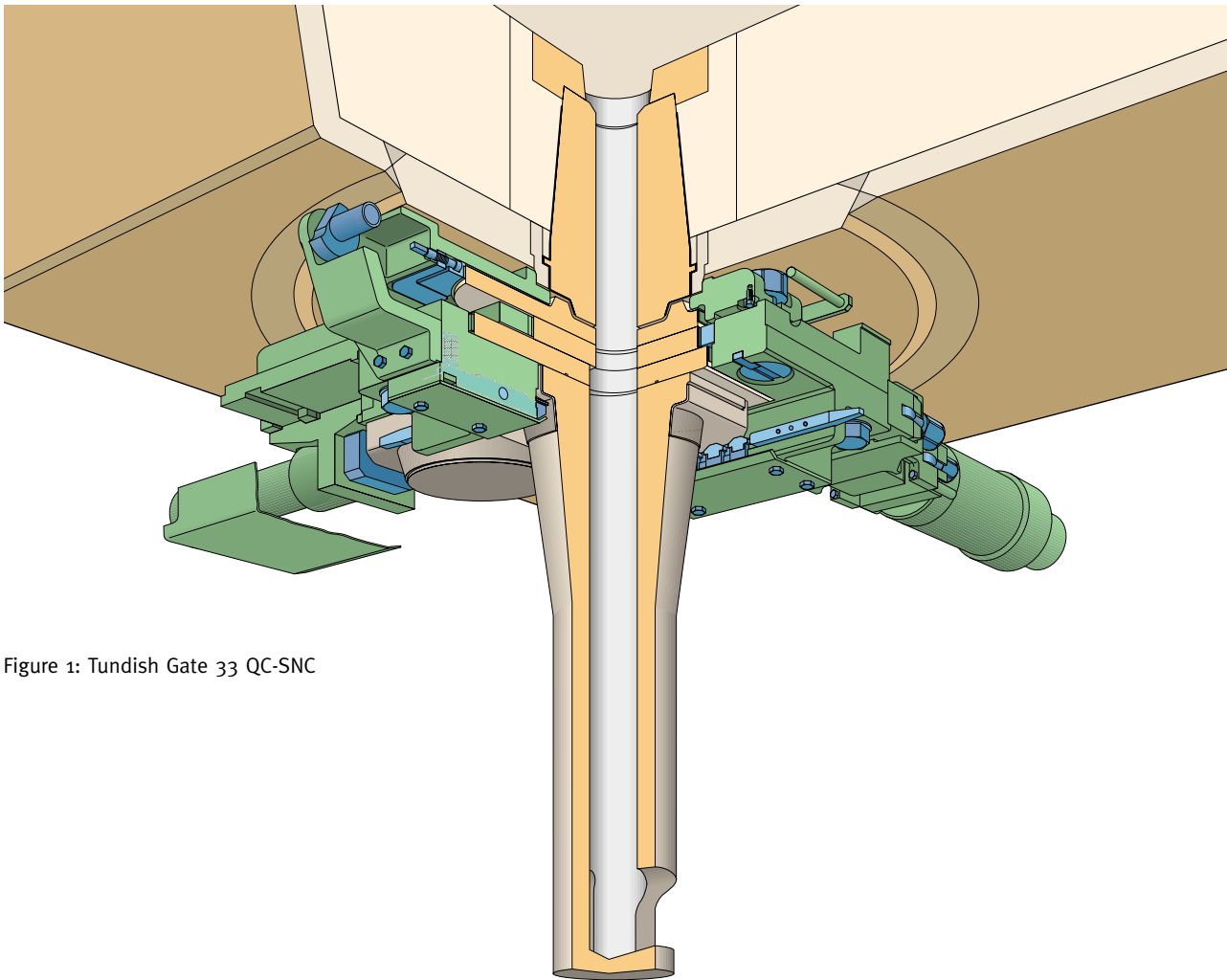


Figure 1: Tundish Gate 33 QC-SNC

A new tundish gate with an integrated submerged nozzle changer has been developed and installed on a slab caster at ISPAT Mexicana in Lázaro Cárdenas, Mexico. It enables changing a worn or clogged submerged nozzle while casting, without interrupting or even stopping the casting process. Thereby sequence length and availability of the caster have been increased and costs reduced.

In its efforts to improve the capabilities of molten metal flow control technology, Stopinc AG has developed an optimized tundish gate system for its steel making customers. This new product includes a tundish gate system which has all possible technical improvements focused on improving steel quality with the additional achievement of reducing costs through the possibility of changing a SN without interrupting the steel flow. The new system effectively combines the proven 33 QC tundish gate technology with the developments of the INTERSTOP Non Stop SN-changer (SNC-N). The name of the new system is INTERSTOP 33 QC-SNC and was designed specifically to fulfil the needs of today's steelmakers.

In addition to the possibility of changing a SN without cast interruption, this system contains another feature which is critical of making quality steel:

The flow control of liquid steel is done crosswise to the length of the mould. This allows a uniform discharge of steel through the SN ports regardless of the position of the throttling plate.

## 1. Introduction

The steel plant of ISPAT Mexicana S.A. de C.V. in Lázaro Cárdenas, Mexico, shows the following lay-out:

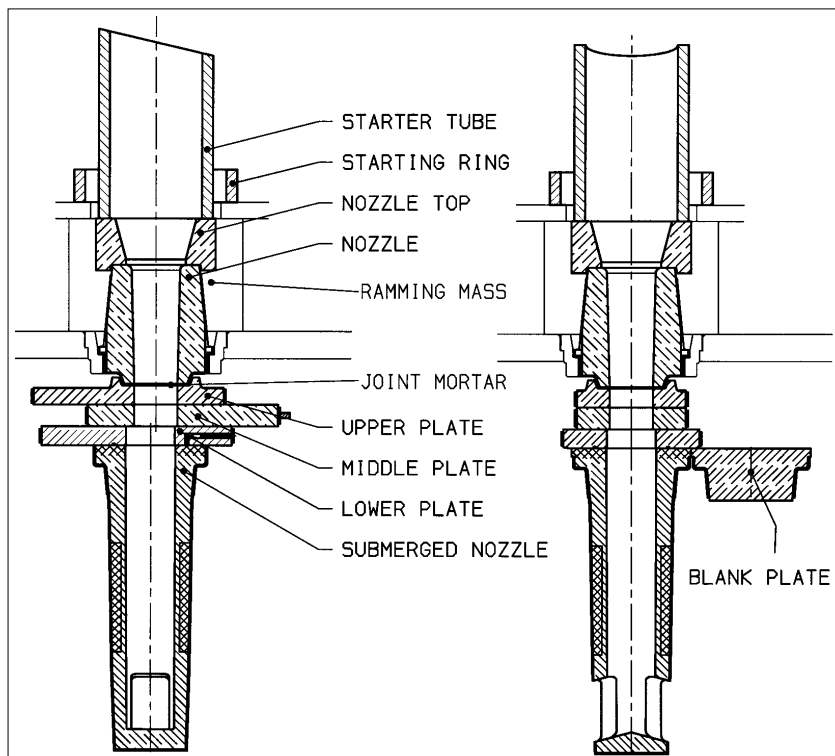
- EAF: 4 x 220 tons
- Production: 3'500'000 tons per year
- Degassing: 1 vacuum degassing unit
- LF: 2
- CCM: 2 x 2 strand slab caster, max. casting speed: 1.3m/min
- Section sizes: 200/225/250x965-1900
- Tundish: Capacity 35 tons, flying tundish exchange
- Steel Grades: Pipe, deep-drawing qualities, appliance sheets, structurals
- Argon gas: to tundish nozzle and groove between lower plate/submerged nozzle

## 2. Tundish Gate with Submerged Nozzle Changer TYPE 33QC-SNC

Flexible production programs are inevitable for the steel plant management to be on the competitive side of the steel market. Today it is most common that the sequence length of a caster is determined on specific order quantities which often exceeds the capability of the weak point in the casting process, the submerged nozzle.



Figure 2: Compact system, minimal space requirements



To increase the tundish life, sequence length and casting yield the newly developed 3-plate tundish gate type 33QC-SNC was installed in replacement of a 2-plate tundish gate system in order to achieve a production increase of 20%.

### Mechanics

- The refractory components of the gate system are held in compression through the use of two independent tensioning systems. The upper and middle plate are pressed against the fixed lower plate. The SN is held against the bottom of the lower plate by the second tensioning system. These independent tensioning systems guarantee an optimal tension distribution in all control positions. Additionally, the supply of inert gas through a circular groove between the lower plate and SN protects the pouring channel against atmospheric ingestion.
- The off-line refractory exchange reduces the number of gates needed in the tundish rotation.
- The compact design allows installation even with minimal clearances available.
- Inert gas injected from the upper plate or nozzle can be used for start-up with throttle plate closed.

### Refractory

- The ready to use refractory parts facilitate gate assembly and prevent misassembling.
- The size of the refractories allow cost advantages.
- The nozzle can be set from the inside or outside of the tundish.
- Better utilization of the throttle plate due to the possibility of emergency shut-off with the blank plate.

### Handling

- To take advantage of a closed circuit, both hydraulic cylinders (the cylinder for flow control and the one for the SN change) are permanently installed on the tundish car and can be connected to the tundish gate very easily.
- The modular structure allows a reduced stock of spare parts.
- The foolproof design guarantees a safe handling.

### Automation

All state of the art technologies are integrated:

- Fully automatic start-up
- Mould level control
- Oscillation in order to improve the refractory plate life and control
- Cast interruptions possible due to oscillation
- Break-out detection and overflow protection programs
- End of cast programs for the optimization of the slab length

### SN-Change

- The minimized head size of the SN allows a SN change without lifting the tundish for almost every mould width

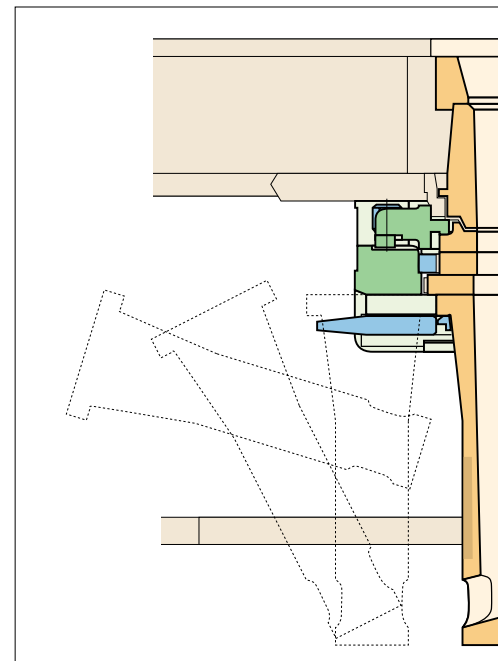


Figure 3: Refractory Lay-out

### SN-Change Operation

- The new (cold or preheated) SN is brought into the mould and set onto the changing mechanics with the help of a manipulator. By pressing a push button the SN is pushed into the casting position with a displacement speed of 200 mm/sec and the used SN is pushed out simultaneously. The steel flow is only stopped for less than 0,25 sec.
- During the manipulation the automatic flow control stays active and the minimal loss of mould level is quickly compensated through the automatic mould level control.

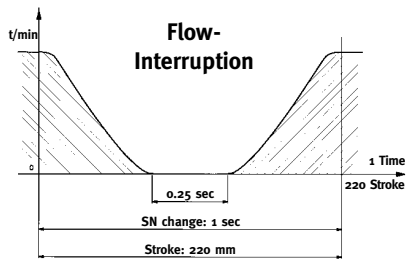


Figure 5: Flow interruption during SN-Change

The handling of the SN's is easy by means of a manipulator, which was supplied according to the ISPAT requirements.

The unique design of the SN head permits a leakproof SN-Change due to the tight push edge technology.

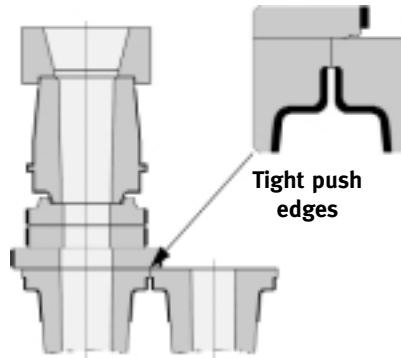


Figure 6: Tight push edges for leakproof SN-Change

At the end of the sequence there is the possibility, for safety reasons, to shut the gate with a blank plate besides of the middle plate. This blank plate can be used several times.

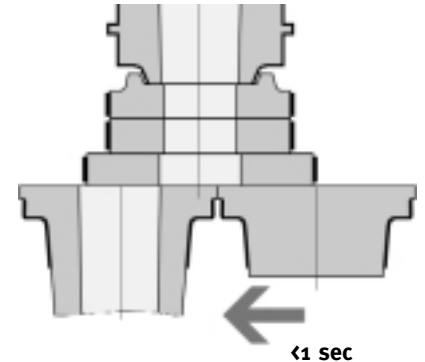


Figure 7: Tight casting end/emergency shut-off with «blank plate»

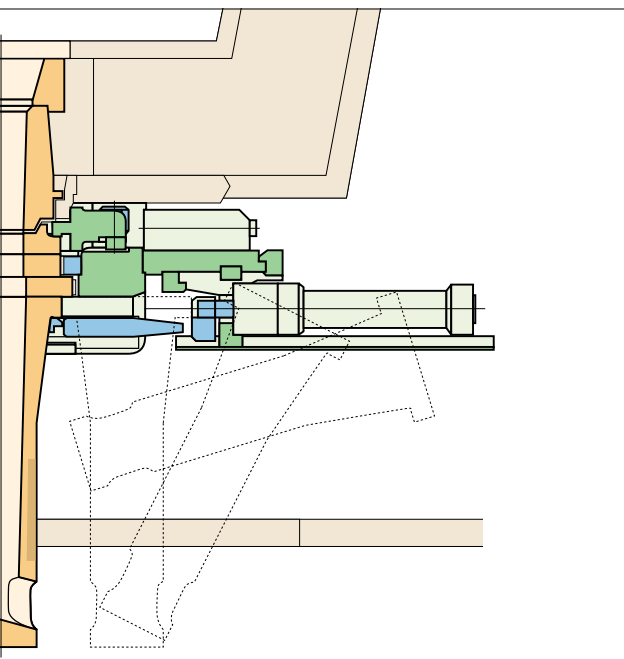


Figure 4: Simulation of SN-Change

### 3. Operation Results

As a result of the introduction of the 3-plates tundish gate with Non Stop SN-Change Type 33 QC-SNC, tundish sequence length has been improved from 6 to an average of 13 (max. 16) and therefore tundish circulation has been decreased by about 50%. With these improvements the following limitations disappeared:

- Limited sequence length: max. 6-8 heats
- Manual strand start-up (failure rate)
- Inaccurate mould level control (old technology)
- Impossibility of SN-Change
- High operation costs
- Limited possibilities to improve the existing TSG-process and technology

The outstanding advantages with the installation of the INTERSTOP Tundish Gate Type 33 QC-SNC are:

- Increased sequence length (average 13 heats), depending on steel grades
- Fully automatic strand start-up
- Accurate mould level from the start of the sequence due to advanced control technology and no oscillation of the SN as with the previous tundish gate

- Automatic controlled SN-Change at a slightly reduced strand speed, therefore no downgrading of slabs
- Modern, simply to maintain drive system (closed circuit)
- System open to any process related improvements

Following costs are reduced due to longer sequences per tundish:

- Cost of refractory for tundish gate
- Cost of tundish working lining
- Cost of tundish safety lining
- Cost of labour
- Cost of energy (preheating)

As a consequence of the longer sequences, the yield was increased and the tundish skulls were reduced by nearly 50%. Consequently to the fewer tundish exchanges and a short submerged nozzle changing time, the resulting cutting scrap has decreased.

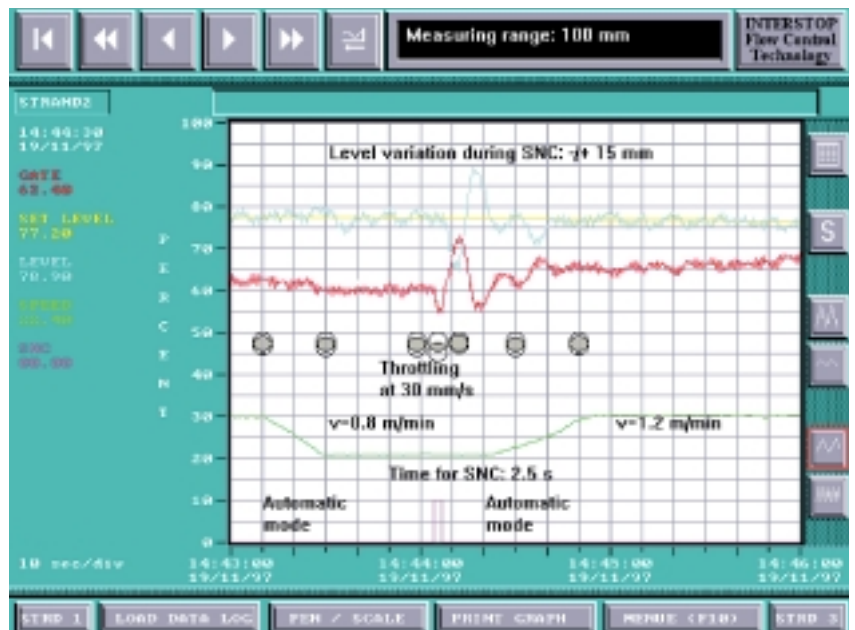


Figure 8: No interruption of automatic mould level control during SN-Change

#### 4. Conclusion

The Tundish Gate Type 33 QC-SNC is a 3-plate linear gate with an integrated submerged nozzle changer which has all the advantages of a tundish gate and the possibility of changing a worn or clogged submerged nozzle while casting, without interrupting or even stopping the casting process.

At Ispat Mexicana the target to increase the productivity was achieved by increasing the sequence length. This has been

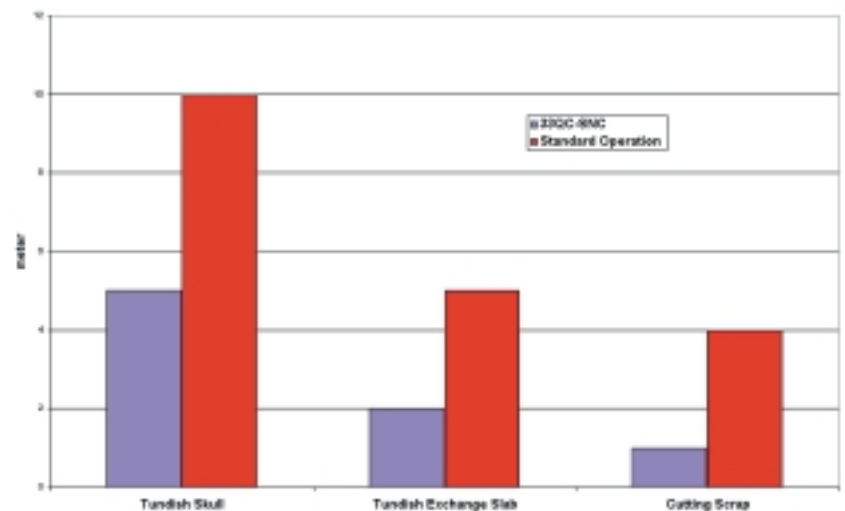


Figure 9: Remarkable increase of the yield

made possible through the on-line submerged nozzle change. From this, cost reductions have resulted with regard to refractory lining, increased availability of the caster as well as less rejected slabs, tundish skulls and cutting scrap.

The evaluation of the results indicates that in a short time the cost can be reduced by nearly 40%, which confirms the short return of investment with the INTERSTOP Tundish Gate 33 QC-SNC.

Presently, all strands on the two slab CCM's are equipped with the Tundish Gate Type 33 QC-SNC.

#### References

- W. Juchhoff, A. Kröker-Buhé, E. Schnurrenberger, A. Pfyl, M. Winkelmann. Operation experience with Submerged Nozzle Changing System. Continuous casting conference, Düsseldorf, June 1994
- G. F. Schlagenhof, P. Gerber, A. Pfyl. Operation of a 3-plate Tundish Gate for slab caster with Non Stop SN-Change Associação Brasileira de Metalurgia e Materiais, Sao Paulo, October 1997
- G. F. Schlagenhof, A. Pfyl. Operation of a 3-plate Tundish Gate for slab Caster with Non Stop SN-Change. The Chinese Society for Metals Beijing, China, October 1997



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