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THE SOUTH EAST ASIAN IRON AND STEEL INSTITUTE (SEAISI) ELECTRIC ARC FURNACE DUST AND SLAG TREATMENT WORKSHOP

KUALA LUMPUR, MALAYSIA
September 6-7, 1993

Prepared By:

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A Project Of:

The South East Asian Iron and Steel Institute
and
The World Environment Center

With Sponsorship By:

The U.S. Agency for International Development (USAID) through WEC's Cooperative Agreement in Support of the U.S. - Asia Environmental Partnership

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DISCLAIMER

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Section 1.

EXECUTIVE SUMMARY

From September 3-9, 1993, Mr. Kenneth L. Minnick, Consultant and retired Environmental Compliance and Planning Manager of Lukens Steel Company visited Kuala Lumpur, Malaysia on a mission sponsored by the U.S. Agency for International Development (USAID) through a Cooperative Agreement with WEC in support of the U.S. - Asia Environmental Partnership (US-AEP). The purpose of this mission was to participated in the South East Asian Iron and Steel Institute's (SEAISI) workshop on Electric Arc Furnace Dust and Slag Treatment. Specifically, the workshop focused on promoting the interchange of information and technologies to better manage, treat and dispose of electric arc furnace dust generated in electric steelmaking in Southeast Asia.

While Malaysia is experiencing a fast-moving expansion of infrastructure and supporting industries, and desires to improve environmental quality and conditions, the Malaysian steel industry and related manufacturing activities appears, to the writer, to be in their early stages of development.

In Malaysia, electric furnace steelmaking is supplying carbon steel for the production of reinforcing bars and small structures and shapes. These products including: small beams, channels, angles, rounds and squares, are currently being consumed in the booming construction industries. No flat rolled products are produced in Malaysia. One comment heard during the conference addressed the availability and use of steel scraps for electric furnace steelmaking, and seemed to indicate that producing an expanded steel product base is of primary concern.

Section 2.

INTRODUCTION

At the invitation of SEAISI, WEC and the US-AEP, Mr. Minnick presented a technical paper on the "Minimization of Dust Generation during Electric Furnace Operation". The presentation and discussions that followed were organized by SEAISI to provide assistance to their members in technologies relating to minimizing dust generation, dust collection, dust recycling, dust treatment and dust disposal.

Section 3.

PRESENTATION

The first session of the workshop was held on Monday morning, September 6. Two technical papers were presented. The first paper by Kenneth L. Minnick was entitled "Minimization of Dust Generation in Electric Arc Furnace Steelmaking".

The purpose of the first presentation was to offer an overview of the best available technologies to reduce dust generation during carbon steelmaking operations and insure maximum capture. The presentation was designed using video tapes to convey a great deal of information in a short time period without over stressing technical and design details.

Mr. Minnick was the first presenter to kickoff the workshop. He opened with a 12 minute colored video tracking a customer's order from beginning to shipment through Lukens Steel Company's facilities. This video highlights air and water pollution controls being used by Lukens. It also gave the small group of participants a comprehensive understanding of Lukens equipment, such as the 150 Metric ton EAF, continuous slab caster, 140 inch wide hot plate rolling mill, heat treatment equipment and computer technology. During the discussion period of the workshop (Session I), in response to a specific question from Dr. Baik Duk-Hyon, President, Research Institute of Industrial Science and Technology, (RIST), Pohang, Korea, Mr. Minnick showed several minutes of a second video that demonstrated visible emissions coming from the roof of a steelmaking shop. The purpose of this presentation was to show a simple methodology to record and evaluate rooftop emissions.

Mr. Minnick handed out hard copies of his paper to the attendees at the conclusion of discussions. A copy of his presentation follows:

MINIMIZATION OF DUST GENERATION IN ELECTRIC ARC FURNACE STEELMAKING

ABSTRACT

The object of this paper is to define the best available technologies to reduce dust generation durning carbon steelmaking operations, and to insure maximum capture/collection and to discuss the available options for recycling or reuse of electric furnace dusts.

The use of clean dry iron and steel scrap will significantly reduce exhaust fumes and gas cooling requirements, as well as, generate other operational and metalurgical benefits. Dust generation using clean dry metallics should range from 10 to 15 pound per liquid melt ton. The potential BTU in the scrap charge has a major effect on establishing the design parameter for a primary fume system.

Selection of scrap, oxygen usage, size of transformer, auxiliary fuel burners and specific furnace practices, such as foaming slag, melt down rates, etc. must be pre-established in order to design peak conditions for the primary fume system.

If the electric furnace steelmaker must use painted, wet, trashy and/or oily metallics, special design concepts need to be evaluated to bring the facility into compliance with appropriate air pollution regulations. Actual dust generation under this mode of operations could range from 35 - 50 pounds per liquid melt ton, with increasing percentage of heavy metals.

Scrap pre-heating is a major alternative to be considered if clean dry scrap is not available due to supply or economic limits. Should scrap pre-heating be considered for normal day-to-day operations, the design of the primary fume system can be reduced in capacity with direct cost savings to help offset increased expenses incurred from additional pre-heating equipment.

Charging and tapping fume generation and capture/collection must be carefully analyzed with or without scrap pre-heating.

In the design of all fume collection systems; (1.) primary, (2.) canopy, (3.) total building evacuation, the engineer must control capital funding, minimize operating and maintenance costs. This provides a strong incentive to design a system with simplicity, proven technology and minimum energy requirements.

An alternative to the high volume of dust disposal is recycling first generation dust back through an electric arc furnace. This method is expedient and cost cutting for disposal, however it is only practiced by a few electric steelmaking melt shops throughout the world.

Instead of the landfill disposal of treated dust, reclamation and/or reuse procedures will be summarized under waste material treatment technologies, based on the author's experience.

MINIMIZATION OF DUST GENERATION IN ELECTRIC ARC FURNACE STEELMAKING

By Kenneth L. Minnick

INTRODUCTION

This paper has been prepared to describe the best available technologies to minimize electric arc furnace dust, generated during carbon and low alloy steelmaking.

It also describes in general the functional and conceptual requirements necessary to design a primary fume system acceptable to both operating and maintenance personal. Substantial assistance from both groups and top management will be required to establish and resolve differences in operating and design.

If time permits, I will provide alternative ways to dispose of electric furnace dust containing high percentages of heavy metals through reuse and/or reclamation processes.

OVERALL ASSESSMENT OF DUST GENERATION

By far, the major contribution to the dust and heat loads in the primary fume exhaust system comes from the volatile materials contained in various iron and steel scraps.

Therefore, the most conservative approach for designing the primary fume collection system, is to minimize these volatiles. These include moisture (water), oil, painted coatings, galvanized coatings, trash, rubber, etc.

Most electric furnace steel makers will use some or all of the following metallics:

-Direct Reduction Iron (Pellets or Briquettes)
-Pig Iron
-No.1 Heavy Melting - Steel Scrap
-No. 2 Heavy Melting - Steel Scrap
-No. 1 Bundles - Steel Scrap
-No. 2 Bundles - Steel Scrap
-Return Home Scrap.
- Return Electric Furnace Pit Scrap.
- Busheling and Turnings

One plan of action by the steelmaker would be to determine whether a clean, dry charge of metallics is available for melting. Management must determine if an adequate supply of scrap is available, purchase price is affordable and duration of supply is continuous.

Typical output of furnace off-gas temperature, gas composition and dust loadings have been field tested in U.S.A. and large furnace systems performance has been recorded. This allows computer programs to be used to simulate future design conditions.

Since volatile input is minimized through use of clean dry scrap; therefore reducing gas temperature and flow rates from combustion. Heat transfer equations for ducts can be modeled, thus determining the need for water vs air cooled ductwork and a combustion chamber.

In my opinion, the potential BTU in the scrap charges has a major effect on establishing the design parameters for the primary fume system.

During my career at Lukens Steel Company I was able to verify potential BTU in each bucket of scrap, in a semi-quantitative way, using the following criteria:

Oil ----- 18,000 BTU per pound.
Trash-----8,000 BTU per pound
Water----4,000 BTU per pound
Coal-----12,000 BTU per pound

Using yield factors of each metallic charged material with assigned maximum and minimum percentage of oil, combustibles and water in the various charge commodities, one could anticipate and calculate max. and min. average sustained temperatures in the dust collection system.

The order of magnitude generation of dust using the clean dry scrap alternative should range from 10 to 15 pounds per liquid metal ton.

Clearly, flow rate capacity requirements for this alternative are minimized. Smaller duct work, baghouses and fans will result. Operating and maintenance features can be simplified. I recommend a separate primary fume system for each individual electric arc furnace, so that necessary maintenance work can be carried out on miscellaneous equipment, dampers, ducts, fans and drives when the arc furnace is down for scheduled maintenance.

When the steelmaker is forced into using dirty steel scrap due to supply problems or cost consideration, the design of the primary fume system requires a higher level of sophistication.

Field testing has proven, that when using oily and dirty metallic charge materials, with a fast meltdown rate, supplemented with oxy-fuel burners this that condition will produce the highest heat release per unit of time and hence establishes the peak design level for the primary fume system.

Tests show a typical 150 metric ton EAF employing ultra high power and oxy-fuel burners and equipped with a water cooled roof and multiple water cooled side panels will exhibit the following peak heat release in BTU/minute under these furnace operating modes:

Meltdown + Oxy - Fuel----------6,000,000
Oxygen Lancing------------------2,500,000
Oxygen Lancing + DRI-----------4,000,000

These total heat releases (sensible plus chemical) found in the off-gases at the furnace elbow becomes the best data in establishing design requirements for the primary fume system.

You may wish to carry out different furnace operating modes to determine peak heat content per unit of time, especially if your engineers are making modifications to an existing system. Accompanying these heat releases, when using painted, trash ladened and oily metallics the actual dust generation under this mode of operation was 48 pounds of dust per liquid melt ton.

The normal range of dust (particulate matter emission) generation under dirty scrap operation should range from 35 to 50 pounds per liquid melt ton.

The question of interconnecting the primary fume system with canopy or secondary system is usually considered at this time. This idea has been rejected by many steelmakers because the reduced capital costs do not normally off-set technical concerns of flow balancing and maintenance requirements, under a multi-furnace installation. The prime advantage for each furnace being equipped with a separate primary fume system is that necessary maintenance work can be co-ordinated with individual furnace scheduled down time.

After heat release data is available, major design considerations to be considered for the primary fume system,(normally called fourth hole or direct shell evacuation), includes the following:

Furnace Pressure and Controls
Water Cooled Furnace Elbow
Combustion Chamber / Slag Drop Out Box
Type and Diameter of Water Cooled Ductwork
System Leakage
Heat Transfer (Water / Air Cool Ducting)
Radiation or Evaporation Cooling
Applicable Regulations and Community Regulations
Baghouse - Capacity and Type
Fans and Drive
Dust Storage Silo
Dust Unloading

After final selection of design, equipment and suppliers the total capital project cost can be developed. Rule-of-thumb suggested in the U.S.A. that each CFM (cubic foot per minute) of baghouse will cost $10.00 (US). Order-of magnitude capital cost for modifications to an existing system can only be developed after on-site investigation.

At this time, the operation, maintenance personnel and engineers should determine total direct operating and maintenance expenses for the primary fume system (or modification).

At some point during the design and implementation of the steelmaking air pollution control system, one must assess local and government legislation and regulations applicable to the steelmaking facility.

All questions should be answered affecting the planned installation or modification, including agency regulations and permit requirements.

The following summary of areas in environmental matters affecting steelmaking air pollution facilities may assist you.

REGULATIONS	FEDERAL OR LOCAL STANDARD
Ambient Air Quality	Express in micrograms per cubic meter
Visible Emissions	Express in percent capacity
Particulate Matter Emissions	Control Equipment Standard of efficiency in grains per dry standard cubic foot.
New Source Standards	More stringent standards.
Notification to Authorities	Local, Regional and/or Federal.

Another way to reduce generation of dust in electric arc furnace is to use scrap pre-heating. Scrap pre-heating could be an alternative to be considered if clean dry scrap is not available due to supply or economic limits.

Cheaper lower quality scrap can be pre-heated in conventional scrap buckets (modified) prior to charging in the furnace to an average temperature in the 700o F (370oC) range. This process will volatilize moisture, oily and other combustibles there by, lowering subsequent heat releases and reduce particulate matter from the electric arc furnace.

The primary operational benefit from scrap pre-heating is reduced meltdown time therefore, increasing furnace productivity. If pre-heating receives a favorable evaluation by your steelmakers, design personal must consider increased inventory of charging buckets, floor space allocation, control of pre-heat emissions, after burning of fume and dust handling, etc. The pre-heating benefits generated during steelmaking in the electric arc furnace should more than offset increase expenses incurred from additional pre-heating equipment.

In addition to the primary fume control system, the designer must investigate the furnace charging and tapping fume captured/collection system.

The charging fume is normally captured by an over head canopy hood located in the building roof structure. A very large duct will be required to ensure a low system pressure drop. Due to limited space within the building, this duct is normally mounted on top of the structure.

Careful investigation into capacity (CFM) and fan inlet configurations is recommended before selection of layout and equipment is finalized. Redesign and/or rebuilding will carry very heavy financial penalties.

Since charging fume occurs in major bursts which engulf the charging crane, a hood must be designed with the optimum hood face area to match furnace and building configuration.

Tapping emission can also be captured in the same overhead canopy hood located high above the furnace within the melt shop roof truss structure. However, by the time the fume reaches the hood, it is greatly diluted through mixing with cross currents of air and teeming crane interference in the building. If the meltshop has open sides, the cross drafts will deflect the rising plume completely away from the overhead hood.

Designing a tapping fume capture system to improve capture performance has traditionally failed or hardly any noticeable improvement in capture has been achieved.

In the U.S.A., the trend toward total building capture is conceived as the "best available technology" for the capture of furnace tapping fumes. This trend is also due in part to more stringent standards for opacity of emission and neighboring community problems. Building evacuation requires capital expenditures of several million dollars.

The total building capture system can optimize other secondary emission control sources, such as pit fugitive dust, ladle pre-heating, teeming operations, ladle refining emissions, continuous casting emissions etc.

In design of all fume collection systems; (1.) primary, (2.) canopy, (3.) total building evacuation, the engineer must control capital spending, and minimize operating and maintenance costs. These requirements provides a strong incentive to design these systems with simplicity, proven technology and minimum energy requirements.

The steelmaker has an alternative to the disposal of high volumes of electric furnace dust, by recycling first generation dust back through an electric arc furnace. This process requires storage, conveying/transporting and injecting the dust back into the slag bath of the furnace.

Most dust contains high concentration of zinc, lead, chromium and some cadmium which will pose an industrial hygiene problem to shop floor personnel due to their potentially toxic nature.

The steelmaker may have good and valid reasons to restrict some heats of steel from employing dust injection. The more heats with this limitation will require increased volume of dust to be injected in non-critical heats. A material balance using the dust injection process has been most difficult to complete. Most steelmakers feel that slag absorbs the lost zinc and other volatile metals.

This dust injection process is expedient in reducing the volume of dust to be disposed by over 50% and results in direct savings for disposal. To date, only a few electric steelmaking melt shops throughout the World are using this or a modified injection process.

WASTE MATERIAL TREATMENT TECHNOLOGIES

Experts can rarely agree on which of the many commercial and emerging technologies used in final disposal of electric arc furnace dust with high concentration of zinc, lead, chromium and cadmium should be recommended.

The author over more than two decades has disposed of, placed in storage, and/or contracted for reclamation in excess of 400,000 tons of electric furnace dust with the following percentage and range of chemical analysis:

Zn	Pb	Fe	Ca	S	C	Cd
10-24	1-2	25-37	4-15	0.1-0.7	1-4	0.02-0.06

Cr	Al	Si	Mg	Mn	K	Na
0.2-0.8	0.4-1	1-3	1-4	3-4	0.1-1	0.1-0.9

Cu	F	Cl	As	Ni
0.1-0.9	0.3-0.6	1-5	0.002-0.007	0.002-0.01

Most recent five (5) month composite test from a 150 metric ton EAF reveals average zinc content at 11.7%, iron at 35.5% and lead at 1.15%. Twenty-six other parameters were up-dated in this 1989 test. (Available)

Instead of disposal in landfills of treated chemical fix or stabilized electric furnace dust, this author favors reuse and reclamation technologies.

VITRIFICATION PROCESS

The Vitrification or Glassification Process recently installed at Oregon Steel Mills in Hillsboro, Oregon (U.S.A.) is my choice for reuse of electric furnace dust containing high concentration of heavy metals generated in non-stainless steelmaking.

This process, in my opinion, will require 30 to 90 day storage and blending as a prerequisite to maintain uniform chemical quality of resulting ceramic products. The glassmaking phase is operated on a continuous basis, very similar to a typical glass melting process. A series of feedstocks (glass forming materials) provide the chemical mode that will bind within the silicates matrix. Normally these potential silicates are silca sand, cullet (broken up waste glass), clay or other mineral sources. Vitrification requires a high temperature (+1400oC) kiln.

When this process reaches full production and resulting product performance is satisfactory, the generated glass or ceramic products can be sold and reused in refractory, abrasive and/or building markets. After this process is fully proven, other carbon and low alloy steelmakers will surely approve and implement similar processes in their own facility.

HTMR TECHNOLOGY

In my opinion the most appicable reclamation processes for electric furnace dust are (HTMR) high-temperature metal recovery, selective reduction processes. These processes recover zinc and lead by volatilization at selected temperatures.

The most established of these processes is the Wealz Process using a rotary kiln. The Wealz Process is used World Wide. This process has become a regional reclamation center because of its high capacity required to achieve best economic results. Currently tapping fees plus transportation costs is competitive with hazardous landfill disposal costs in the U.S.A. The Wealz product is a crude zinc oxide sold to metal refiners. Recycling of the iron residual back through an electric arc furnace has not been proven economical.

An alternate high temperature selective reduction process is the "gas fired flame reactor" which can be used regionally or at a individual large size steelmaking plant. According to my most recent information on this process it is suitable for onsite facilities producing between 10,000 to 20,000 tons of dust annually. A group of smaller producers of dust could form a regionalized facility.

Both HTMR technologies destroy all organics in the electric furnace dust (K061) due to high operating temperatures.

Preliminary engineering is under way for two commercial sized gas fired Flame Reactor Plants in the U.S.A. (13,000 and 20,000 tons per year).

CLOSING

I would like to thank each of you for this opportunity to relate my opinions here today on electric arc furnace dust.

With the time constraints each of you have, I hope this exchange of technical, environmental and engineering information will assist you in future activities.

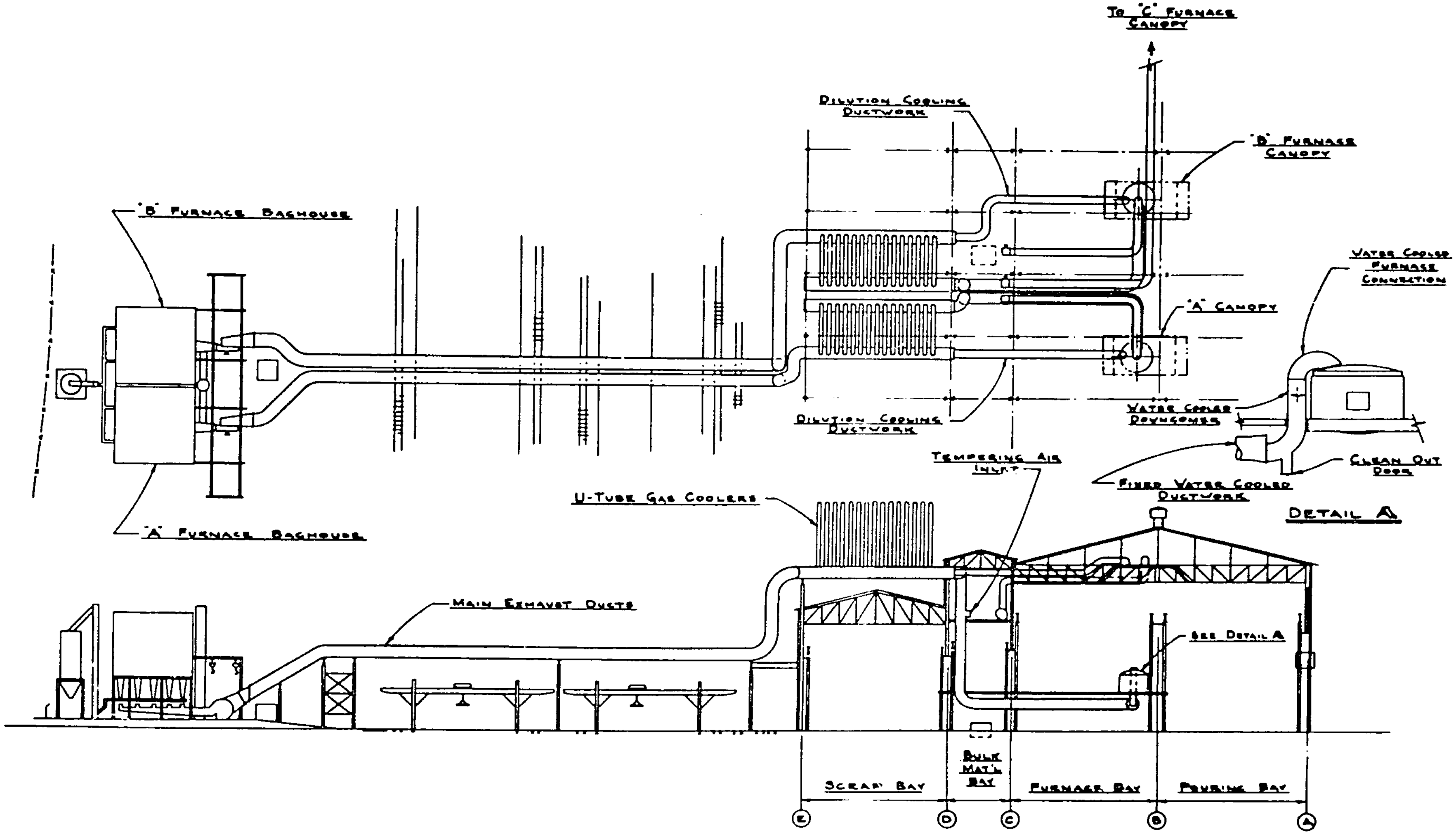
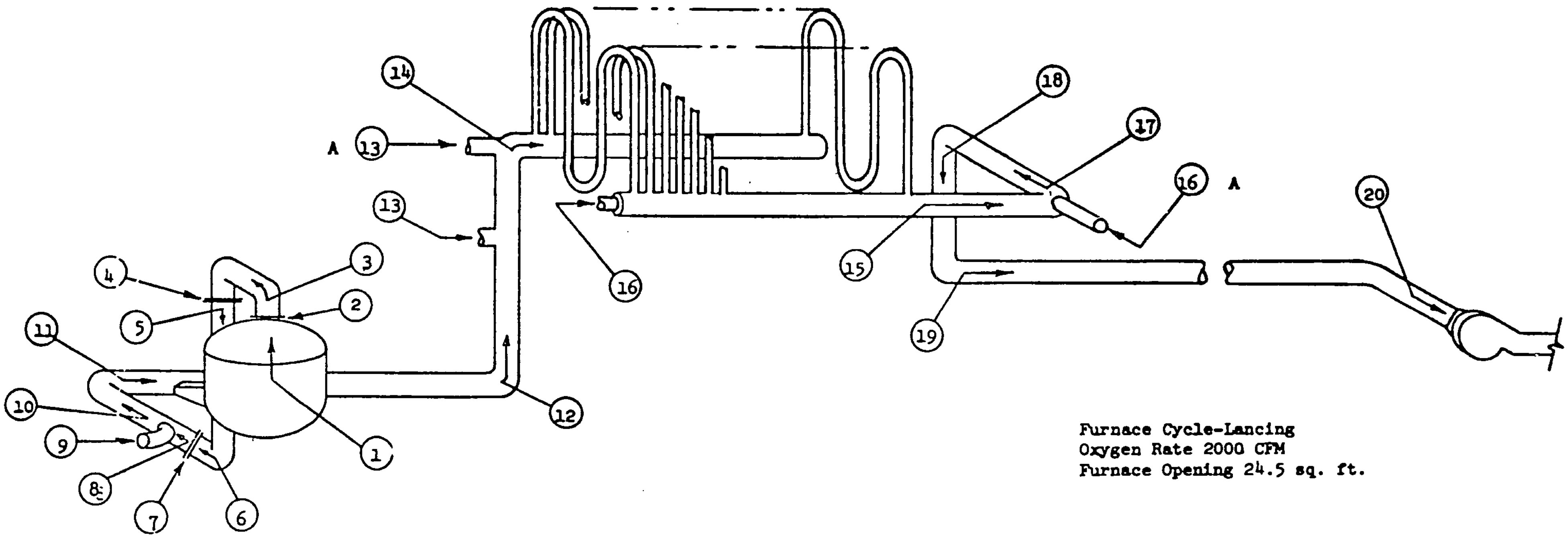


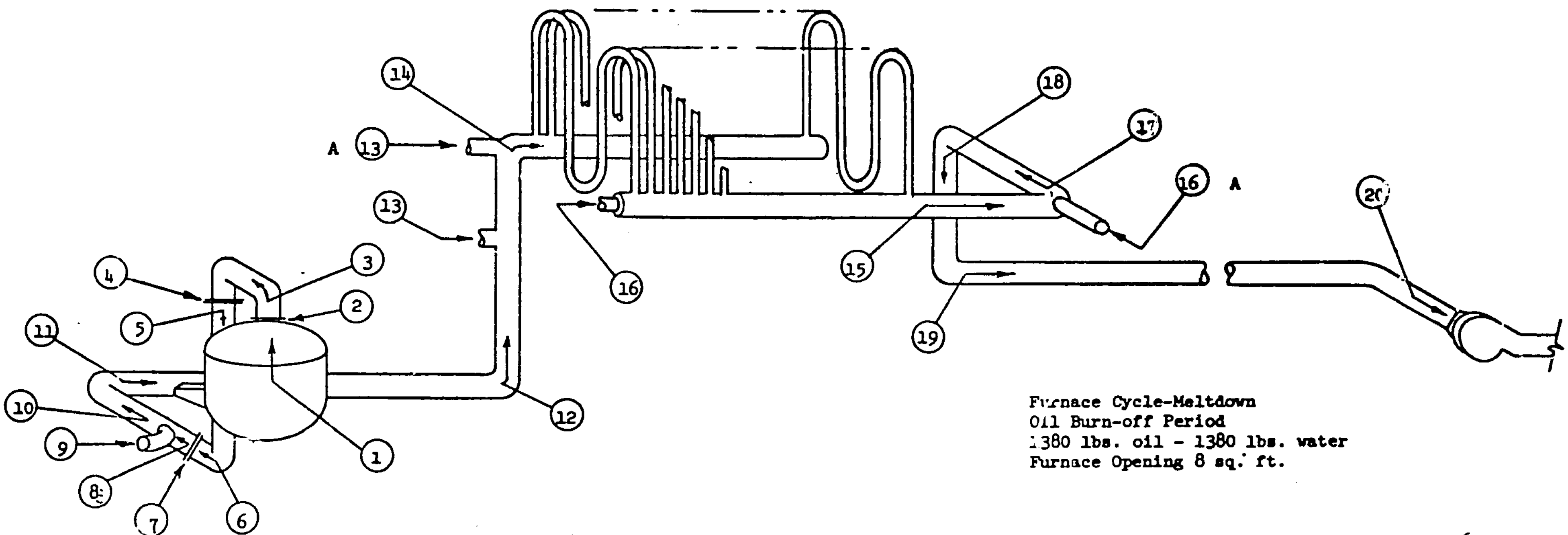
FIGURE 1 FUME CONTROL SYSTEM



Furnace Cycle-Lancing
Oxygen Rate 2000 CFM
Furnace Opening 24.5 sq. ft.

LOCATION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
SCFM	28200	1500	29700	1500	31200	31200	1500	32700	0	32700	32700	32700	1030	33730	33730	50200	83930	83930	83930	83930
Temperature, °F	2480	100	2460	100	2174	2009	100	1921	X	1724	1724	1309	100	1150	560	100	285	283	282	270
ACFM	156000	X	164000	X	15500	145000	X	148000	X	135000	135000	109000	X	102000	64900	X	118000	117700	117500	115600
Duct Dia., in.	48	X	48x48	X	48x48	48x48	X	66	X	66	66	66	X	66	66	X	66	66	66	66
Static Pressure, " w.g.	-.05	X	-3.20	X	-4.49	-6.41	X	-6.41	X	-6.44	-6.59	-6.82	X	-7.01	-8.60	X	-8.86	-9.28	-9.65	-11.18
Distance from furnace, ft.		0			10	30					60	170	225	255						

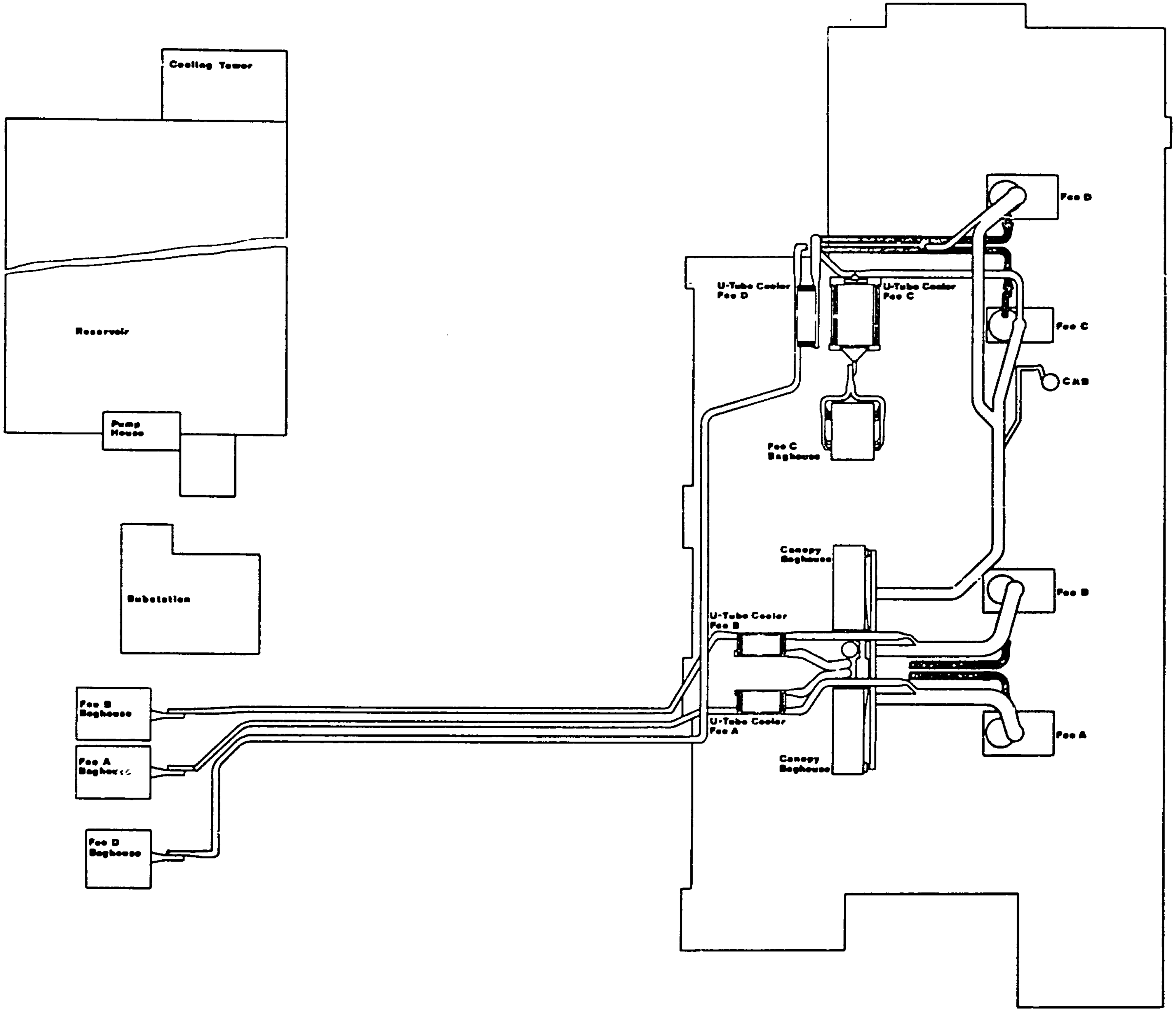
FIGURE 2.1 SYSTEM SCHEMATIC-OXYGEN LANCING



* Modulating Control Damper Between 5 and 6

LOCATION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
SCFM	7610	1500	8780	1500	10267	10267	1500		14121	25888	25888	25988	1307	27195	27195	28665	55860	55860	55860	55860
Temperature, °F	3436	100	3830	100	2882	2037	100		100	2820	2148	1377	100	1150	480	100	285	282	280	270
ACFM	55941		71068		64740	48371				160213	127388	89729		82611	48233		78520	78200	78000	76940
Duct Dia., in.	48		48x48		48x48	48x48		-		66	66	66		66	66		66	66	66	66
Static Pressure, " w.g.	-.05		-.30		- 42	*														
Distance from furnace, ft.		0			10	30						60	170	225	255					

FIGURE 2.2 SYSTEM SCHEMATIC-MELTDOWN



EMS Air Pollution Control
Lukens Steel Co.

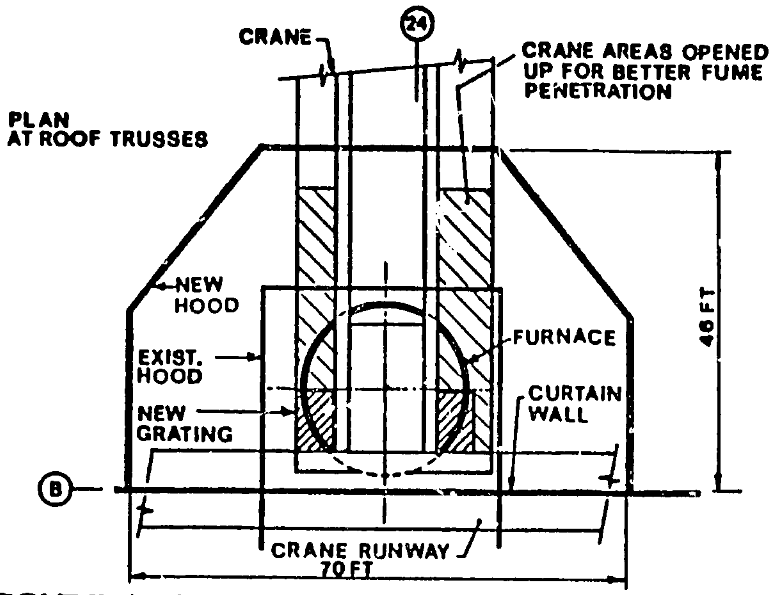


FIGURE 4 CANOPY HOOD AND RELATED CHARGING CRANE MODIFICATIONS

Section 4.
RELATED CONFERENCE DETAILS

The second paper by Larry M. Southwick was entitled "Regulatory Impacts of Commercializing EAF Dust Technology". Mr. Southwick's presentation placed most of its emphasis on US-EPA regulations encountered when managing treatment and disposal of electric furnace dust. The attendees were preoccupied reading his paper during the presentation, which was given out prior to the formal opening of Session I.

The agenda for Session II and III is included in Appendix A. The staff of SEAISI were present and tape recorded all three sessions (presentations and discussions).

SEAISI ENVIRONMENTAL COMMITTEE MEETING

The attending members of the SEAISI Environmental Committee convened a closed-door committee meeting after lunch which continued for approximately four hours. The writer assumed their discussion centered around a future meeting (time, place and subject). No specific information resulting from this meeting was provided.

Section 5.

FINDINGS AND RECOMMENDATIONS

Southeast Asia is experiencing vigorous to explosive growth, and offers tremendous opportunities for U.S. construction and environmental companies to develop appropriate business connections and joint partnerships with existing companies.

This workshop in my opinion was offered at a good time as the Malaysia steel industry is still immature but interested in future growth. In this area of growth, interest and concern about future environmental matters must not be forgotten or deferred.

My overall impression of the workshop was prejudiced by the Asian presenters, who read their presentations word by word. It is the Asian's customary procedure to distribute the printed papers to the audience before hand. This practice results in the individuals reading along with the presenter, thus failing to get the big picture or having sufficient time to formulate good questions. Most questions to the Asian presenters were to clarify or expand on their written papers.The bulk of questions and interest of the group was directed at treatment and disposal of electric furnace dust.

Session III held on Tuesday September 7, 1993 was oriented to the commercialization of different treatment technologies. These presenters offered to follow-up with more detailed sales pitches at individual sites, if desired. Discussion was generally centered on the costs and performance of each process.

The following recommendations are made:

- On going and future interchanges of environmental technologies, regulations and other appropriate environmental management concerns should be continued to maximize sound use of time and money in the developing countries.

- In today's international arena, as more and more air, water and solid waste regulations are being developed and enforced, and public awareness regarding environmental issues is increasing, I strongly recommend that the steel industry address pollution issues up front and be proactive with governmental bodies and their local communities.

- WEC should continue to provide a leadership role as a facilitator of these environmental conferences, workshops and interchange of emerging technologies.

APPENDIX A: AGENDA

SOUTH EAST ASIA IRON & STEEL INSTITUTE

SEAISI EAF WORKSHOP ON DUST & SLAG TREATMENT
6TH & 7TH SEPTEMBER 1993
MOHAR ROOM, HOTEL NPC, Jalan Barat, Petaling Jaya
WORKSHOP PROGRAMME SCHEDULE

6th Sept 93: (Monday):

0830-0845	Arrival of Committee Members Participants.
0900-0915	Opening Speech By Dr. Baik Duk-Hyon.
Session I:	On Minimization of Dust Generation During Operation: (Chairman : Mr. Tsai)
0915-1000	Presentation by Mr. Kenneth Minnick, Consultant, Paper: "Minimisation of Dust Generation In Electric Arc Furnace Steelmaking".
1000-1045	Presentation by Mr. Southwick of Southwick & Assocs. Paper: "Regulatory Impacts of Commercializing EAF Dust Technology"
1045-1115	Coffee Break
1115-1230	Discussion
1230-1350	Workshop Lunch Break at NPC Hotel, Poolside Restaurant.
Session II:	Advanced Technology on Dust Collection: (Chairman: Mr. Leo Selleck)
1400-1445	Presentation by Mr. Talwoo Lee, Chairman of Korea Cottrell Co. Ltd. Paper: "Air Pollution Control System for EAF Plant"
1445-1530	Presentation by Mr. Yoji Nomura, Deputy General Manager (Resources Recycling Engr. Dept) of Aichi Steel Works. Paper: "EAF Dust Treatment In Japan"
1530-1600	Coffee Break

1600-1645	Presentation by Prof.Dr. Ban Bong-Chan of Suncheon National Univ., College of Engineering, Korea. Paper:"EAF-Dust Treatment by DC-ARC Furnace with Hollow Electrode & New Concept of Dust Recycling".
1645-1800	Discussion
1930	Dinner Hosted by MISIF (Attendance By Invitation from MISIF)

7th Sept 93: (Tuesday):

Session III: Waste Material/Slag Treatment: (Chairman : Dr. Choi)

0830-0915	Presentation By Mr. Brian Lightfoot, Executive Director of Ausmelt Pty Ltd, Australia. Paper: "EAF Dust Treatment Using Ausmelt Top-Submerged Lance Technology"
0915-1000	Presentation By Mr. Alan Sarkos from Inorganic Recycling Corpn, Ohio, USA. Paper: "Vitrification of EAF Dust"
1000-1030	Coffee/Tea Break
1030-1115	Presentation by Dr. Liou Ding-Chung, Research Scientist of I.T.R.I., Union Chemical Labs, Taiwan. Paper: "Stabilization/Solidification Treatment of Electric Arc Furnace (EAF) Steel Dust".
1115-1230	Discussion
	END OF WORKSHOP SESSIONS.
1230-1345	Workshop Lunch at Hotel NPC, Poolside Restaurant.

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SOUTH EAST ASIA IRON & STEEL INSTITUTE

SEAISI EAF DUST & SLAG TREATMENT WORKSHOP
6th & 7th Sept., Mohar Room, NPC Hotel, P.J.

List Of Participants

Experts Speakers:

1. Mr. Yoji Nomura Dinner - for 2 - Tues Evening.
   Deputy General Manager
   Resources Recycle Engineering Dept
   Aichi Steel Works Ltd, Japan.

2. Mr. Talwoo, Lee Electrical Engr
   Chairman of Korea Cottrell Co. Ltd.,Korea. (Seoul)

3. Mr. Brian Lightfoot
   Executive Director of Ausmelt Pty Ltd., Australia.

4. Mr. Southwick, President of Larry Southwick & Associates, U.S.A. I.T. Corp.

5. Dr. Ding Chung Liou
   Research Scientist of I.T.R.I. Union Chemical Labs
   Taiwan, ROC.

6. Mr. Alan Sarkos from Inorganic Recycling Corpn
   Ohio, USA (nominated from WEC/US-AEP)

7. Mr. Kenneth Minnick, Consultant, (nominated from WEC/US-AEP)

8. Prof. Dr. Ban Bong-Chan of Suncheon National University, College Of Engineering, Dept of Metallurgical Eng., Korea.

SEAISI Environmental Committee Members:

9. Dr.Baik Duk-Hyon Dinner - Sunday - opening Speaker
   Chairman of Committee & Director of SEAISI
   President of RIST (Research Institute of Industrial Science & Technology), Korea. (Pohang)

10. Mr. Leo Selleck
    Group Manager - Environment Chairman - Adv Tech on Dust Collection

11. Mr. M. Takemura
Deputy General Manager
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APPENDIX D
List of Presentations and Documents

PRESENTATIONS

1. **Regulatory Impacts of Commercializing EAF Dust Technology**, Larry M. Southwick, L.M. Southwick & Associates, Cincinnati, Ohio, U.S.A.

2. **Air Pollution Control System for Electric Arc Furnace Plants**, Tal Woo Lee, Chairman, Korea Cottrell Co., Ltd.

3. **EAF Dust Treatment in Japan**, Yoji Nomura, Resources Recycling Engineering Department, AICHI Steel Works, Ltd., Japan.

4. **EAF-Dust Treatment by DC-ARC Furnace with Hollow Electrode and New Concept of Dust Recycling**, Professor, Dr.-Ing. B.C. Ban, Dr.-Ing. B.M. Lim, Department of Metallurgical Engineering, Suncheon National University, Suncheon, Korea.

5. **EAF Dust Treatment Using Ausmelt Top-Submerged Lance Technology**, J.M Floyd, P.J. King, W.E., Short, Ausmelt Pty, Ltd., Australia

6. **I.R. Recycling Vitrification Process**, A.B. Sarko & L.S. Sarko, I.R. Services Corporation, Dublin, Ohio, U.S.A.

7. **Stabilization/Solidification Treatment of Electric Arc Furnace (EAF) Steel Dust**, Liou Ding-Chung, Ph.D., Union Chemical Laboratories (UCL), Industrial Technology Research Institute, Hsinchu, Taiwan.

8. **Treatment of Electric Arc Furnace Dust with a Sustained Shockwave Plasma Reactor**, Malcolm T. Hepworth, J.K. Tylko, and Hua Han, University of Minnesota, Department of Civil and Mineral Engineering, Minneapolis, Minnesota, U.S.A.

DOCUMENTS

1. **Lukens: Remarkable Past -- Promising Future**, Luken Steel

2. **The Clean Air Company**, Korea Cottrell Co., Ltd.

3. **The Research-Cottrell/Teller Emissions Control System: Proven Technologies for Cost-Effective Emissions Control**, Korea Cottrell Co., Ltd.

4. **Hollow Electrode Smelting System (HES System)**, Mannesmann DEMAC

5. **Designers and Suppliers of Ausmelt Smelters**, Ausmelt

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9th Sept 1993

Mr. Kenneth L. Minnick, P.E.
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West Chester, PA 19382
U.S.A.

Dear Mr. Kenneth Minnick,

Re: SEAISI EAF Dust & Slag Treatment Workshop:

We wish to thank you for your participation and presentation of your Paper on "Minimisation of Dust Generation In Electric Arc Furnace Steelmaking".

We believe that your Paper was well received by the SEAISI Environmental Committee Members, the invited local industrial observers and all those present at the Workshop.

We thank you for your contribution and look forward to your continued participation in our future activities.

Kind Regards,

Jai Eun Lee

Lee Jai Eun
Secretary General