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TRIP REPORT TO POLDI UNITED STEEL WORKS AT KLADNO, CZECHOSLOVAKIA

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TABLE OF CONTENTS

Page

I. EXECUTIVE SUMMARY 1

II. FINDINGS 2

A. INTRODUCTION 2

B. AIR POLLUTION CONCERNS 2

1. Steelmaking Furnaces 3

a. "Drin" Works 3
b. "Old Works" Newer Open Hearth Shop 3
c. "Old Works" Old Open Hearth Shop 3
d. POLDI Works POLDI 1 4
e. POLDI Works POLDI 2 4

2. Powerhouses 4

C. WATER POLLUTION CONCERNS 5

D. SOLID WASTE CONCERNS 6

1. Specific Solid Wastes 7

a. Steelmaking Slags 7
b. Fly Ash and Cinders 7
c. Scale 8
d. Spent Refractories 8
e. Sludge from Waste Water Treatment 8
f. Grinding Wastes 8
g. Miscellaneous Wastes 9

2. Landfill 9

3. Incinerator 9

III. RECOMMENDATIONS AND CONCLUSIONS 10

EXHIBITS 11
Exhibit 1 - History of POLDI
Exhibit 2 - Plan of POLDI Plant

FIGURES 12
Figure 1 - Water Flow Diagram

TABLES.....13
TABLE I - Water Quality Data

Persons Consulted.....14

Biographical Sketch of Author.....15

I. EXECUTIVE SUMMARY

An environmental review was made of the operations of POLDI United Steel Works at Kladno, Czechoslovakia.

The POLDI plant has severe air pollution problems from its steelmaking and powerhouse operations. Management has developed plans for a program which will completely restructure the steelmaking facilities of the plant and will convert the powerhouses from coal to gas. When complete this program will solve the major air pollution problems.

The water system of the plant is complex but basically treats all waste water from all sections of the plant in a central treatment facility. The effluent from this central treatment facility joins the waste waters from the community of Kladno and is subjected to further biological treatment before discharge back to the river. Effluent quality is uniformly good and in compliance with permit conditions. No need is seen for changes in this system.

Relative to solid wastes, the management of existing landfills is outstanding. Limitations on future land disposal established by the Czechoslovakian government, however, make future landfilling questionable. POLDI is presently processing some of its wastes for reuse and management is seeking ways to increase reuse. Handling of some wastes, particularly combustible wastes, is environmentally bad. Management plans for an incinerator should solve this problem.

All in all, it is concluded that the POLDI plant has serious environmental problems with air pollution and solid waste handling. Management seems to be fully aware of these problems and is working on their solution. There are no short-term easy fixes.

Management's plans for major upgrading of the plant, including rationalization of steelmaking facilities, conversion of boilers to gas firing, installation of an incinerator, and increased reuse of solid wastes could make the plant environmentally acceptable.

II. FINDINGS

A. INTRODUCTION

POLDI is a 100 year old steel producing facility in Kladno. Today it is a large complex plant spread over an area of about 4km by 2-1/2km. For a brief history of the plant see Exhibit 1. The plant has three major areas: the "old" works, the "POLDI" works and the "Drin" works. The Drin works produces primarily carbon steels; the POLDI works produces a great deal of alloy and stainless steels, and the old works a variety of products. Steel is made in all three areas. Although at one time the plant included integrated steel facilities, all coke ovens and blast furnaces have been shut down and partially or completely demolished.

The purpose of this visit to the plant was to conduct an environmental review of the POLDI plant. The first impression was better than anticipated, largely because coke ovens and blast furnaces had been shut down. Furthermore, the steelmaking operating level of the plant is currently low, so that pollution from most sources is somewhat reduced. The general appearance of the plant deteriorated significantly, however, as weather changed from bright and clear to hazy and overcast with no wind.

It quickly became obvious that the plant has severe air pollution problems. Details of these problems are discussed in a later section. There are also serious and worsening problems with the handling and disposal of solid wastes. These are also discussed below.

Plant management seems to be fully aware of the air pollution and solid waste problems and has developed plans to solve them. These plans generally incorporate upgrading and modernization of facilities rather than addition of "end-of-pipe" pollution control equipment. The proposed modernization will result in somewhat reduced capacity of the plant, consolidation of steelmaking facilities and shutdown of obsolete facilities. Large investments will be required. Management has expressed confidence that these programs will proceed, but has also expressed serious concern about the availability of capital funds, particularly in the current period when production levels are low because of lack of orders and loss of markets.

B. AIR POLLUTION CONCERNS

The principal sources of air pollution which are of concern include steelmaking furnaces and powerhouses. A plan of the complete works showing the location of each facility discussed in this section is included as Exhibit 2. Other furnaces throughout the plant are fired with natural gas and present no apparent environmental problem.

1. Steelmaking Furnaces

There are now five steelmaking shops within the overall works, one in the "Drin" works, two in the "POLDI" works, and two in the "Old" works.

a. "Drin" Works

This shop has two 100T electric arc furnaces with rated capacity of 420,000 T/yr. These furnaces are equipped with a direct extraction (fourth hole) air pollution system connected to a baghouse. The baghouse discharge appears clean, indicating that this system is satisfactory for the major emissions that it captures. However, there are no secondary controls. During a part of the steelmaking cycle, there is severe leakage around the electrodes. Charging and tapping are completely uncontrolled with copious emissions into the shop atmosphere. During this visit, only one furnace was operating, the other down for maintenance. Nonetheless, the shop atmosphere was heavily dust laden. All these emissions reach the atmosphere through open monitors. They are highly visible inside and outside plant boundaries.

The Management plan is to shut down one of these two furnaces, making up capacity by greater efficiency and productivity on one furnace, and to install complete canopy hoods and additional baghouse capacity to capture furnace leakage and charging and tapping emissions. When completed, these steps should result in satisfactory control of emissions from this shop, making it environmentally acceptable.

b. "Old Works" Newer Open Hearth Shop

This shop, not currently operating, has 30T and 50T open hearth furnaces with no air pollution control systems. Management has no plans to operate this shop and indicates it will be shut down permanently. That appears to be the only solution acceptable environmentally.

c. "Old Works" Old Open Hearth Shop

This shop has five 30T open hearth furnaces and a 25T and a 29T electric arc furnace. The open hearth furnaces have no air pollution control systems. The electric arc furnaces are equipped with direct extraction systems. When they were observed, there were very heavy emissions visible both inside and outside the building during refining even though the direct extraction system was in operation. If the electric arc furnaces were to continue to operate, better direct extraction systems plus extensive canopy hooding would be required. However, Management indicates that this shop will also be shut down in the near future. That appears to be the best solution environmentally.

d. **POLDI Works POLDI 1**

This shop has one 3-ladle vacuum induction furnace for the production of stainless steel and two 30T electric arc furnaces for production of alloy steels. The vacuum induction furnace is clean and presents no problem. The electric arc furnaces are equipped only with direct extraction systems. These systems cannot be operated throughout the furnace cycle so that there is extreme leakage during operation as well as uncontrolled charging and tapping. Management has indicated that it plans to discontinue operation of this shop. The vacuum induction furnace will be moved to POLDI 2 and the electric furnaces will be replaced by the new furnace in POLDI 2.

e. **POLDI Works POLDI 2**

This shop, the newest in "POLDI Works" has three 30T electric arc furnaces and a ladle treatment system. Each furnace has a direct extraction system and these along with the ladle treatment station are connected to a baghouse. As with the other furnaces at the works, there is leakage around the electrodes during operation and charging and tapping are uncontrolled. Management plans to replace these three furnaces and the two from POLDI 1 with a single 80T furnace complete with extensive canopy controls and additional baghouse capacity. This one shop, adequately controlled, appears to be an environmentally sound solution for "POLDI Works".

The program proposed by Management will replace five melt shops which have a number of different furnaces, none of which are adequate environmentally, with two melt shops with fewer large well controlled furnaces. Environmentally, this program appears well conceived. Air emissions will be drastically reduced and modern technology will be in place. At the same time, manufacturing efficiency should be significantly improved.

2. **Powerhouses**

The powerhouses in this plant burn "black" coal and emit to the air fly ash, SO_2 and NO_x. The principal powerhouse located in the "old" mill provides steam and hot water for use in the entire plant, generates about one-fourth of the electricity used in the plant, and generates hot water for heating much of the municipality of Kladno. The plant has three boilers, 2-185 T/hr and 1-240 T/hr, all fired with pulverized coal. The off gases are treated in electrostatic precipitators rated at 99% efficient for fly ash removal and then discharged through a tall stack which is visible for miles around. The appearance of this stack leads me to question the 99% efficiency of the precipitator although I have no data on this. Even at low production levels this powerhouse runs at a high percentage of its capacity in winter because the demand for district heating represents a significant portion of its load.

This powerhouse is recognized as a major source of particulate and SO_2 air pollution. Management proposes to rehabilitate these boilers and to reduce, almost eliminate, the air pollution, by conversion to natural gas instead of coal as the primary fuel. This conversion would be very desirable environmentally since it would eliminate a major source of air pollution and, in addition, it would significantly reduce solid waste generation. Its economics seem attractive, since the boilers are now in need of rehabilitation, and conversion to gas may be cheaper then rehabilitation of the coal firing systems. Imported gas, available in the past, would be considerably more expensive than the coal now used, but a project underway to develop gas locally from an underground coal seam will result in the availability of cheap gas.

There is a second boiler house, also in the "old" plant area. This auxiliary powerhouse has two grate-fired boilers burning coal primarily. It is also used as a dumping ground for solid wastes. Some municipal and various mill wastes are burned along with the coal on the grates. This boiler house has no air pollution control system. The emissions are simply discharged through a stack. This boiler house is an obvious and severe source of air pollution. Management has indicated that it will be shut down permanently and its heating load picked up by the main power plant during the forthcoming rationalization. Environmentally this shutdown is essential.

A third powerhouse in the POLDI works has five boilers, three fired by gas and two on fuel oil. It provides supplementary heat to POLDI works but is less economical than the principal powerhouse. Oil is seldom burned. This powerhouse has no apparent air pollution problem.

C. WATER POLLUTION CONCERNS

All water used in the POLDI Plant is pumped from the Vltava river about 15km below Prague. A simplified flow diagram is shown in Figure 1. Two treatment plants at the river produce service water and sanitary water which are pumped separately to Kladno. Service water serves other small industrial operations as well as the POLDI plants. Service water and sanitary water are distributed separately to the three works. Waters are distributed within each works as required. Other than simple scale pits at the rolling mills, there are essentially no waste water treatment facilities within the works. In the "old" works and the POLDI works, all waste waters, both service and sanitary, are combined in a single discharge which flows by gravity to the central treatment plant. At the "Drin" works, sanitary discharges are segregated and discharged through a settling basin to the "creek". Service water discharge flows to the central treatment facility.

The central treatment facility adjusts pH of the incoming water, adds iron and alum as flocculents and treats the entire stream in Dorr flocculator-clarifiers for removal of solids and oil. Sludge from the flocculator-clarifiers is treated with polymeric flocculent agents and filtered to a semi dry solid which is landfilled. The clean overflow from the flocculator-clarifiers is discharged to the "creek" where it is mixed with other water waste from Kladno. The entire creek flows to a biological treatment system 5km downstream.

Table I shows the analyses of the service water received at the plant, the effectiveness of the treatment, the discharge from the central treatment facility and the conditions set on this plant by the permit established by Czechoslovakia in 1986.

Two minor water pollution facilities are of interest, although they have no effects on the discharge of the plant. At the one pickling operation, there is a complete neutralization facility. Neutralized sludge is landfilled or stored and overflow is added to the plant waste water system. Flow is so limited that no effects are shown in the discharge. There are several machining type operations where emulsions are used for special metal working. Used emulsions are taken to a small batch treatment plant near the central waste water treatment facility. Acid and alkaline treatments are used for emulsion treatment.

All in all, the water treatment systems at this plant appear to assure that no water pollution will occur and are environmentally sound. Larger and more modern mills could use less water and provide better environmental protection by the use of treatment systems, recycle systems and water reuse at individual operations within each works. However, in view of the overall satisfactory performance of the water treatment system at this plant, the small size of the many individual mills and the high costs of attempting to retrofit that type systems, there is no reason to consider them for this plant.

D. SOLID WASTE CONCERNS

The principal solid wastes now produced at the POLDI plant are steelmaking slags, steelmaking dusts, fly ash and cinders from coal combustion in the powerhouses, scale from rolling mills, spent refractories, sludge from the central waste water treatment system, grinding wastes, and miscellaneous combustible wastes. In the past most of these materials have been disposed on land in various waste disposal areas. Today, however, regulations of land disposal (including significant payments for dumping), increased concern about the environmental effects of land disposal, and exhaustion of capacity in existing landfill areas require that waste practices be reexamined and new plans developed.

In addition, one problem remains from the previous operation of coke plants at this plant. There are two significant areas, referred to as "Black seas" where there are significant old deposits of tarry wastes--semi solid and combustible. These areas represent a future hazard and a present nuisance.

1. Specific Solid Wastes

a. Steelmaking Slags

Slags from the different steelmaking shops (see section B.1, above) have different characteristics and are treated differently. Slag from the carbon steel production of Drin works are quite suitable for reuse. At present, about 50% of this slag is crushed, the metallic values recovered magnetically, and the crushed residue used as an aggregate. This is an environmentally sound method of recovery and reuse. The remaining 50% of the slag is stockpiled for future reprocessing. Management plans to increase the capacity and upgrade the reprocessing facility so that essentially all of the Drin?? slag will be processed with the residue used as aggregate.

Slags produced at the other steelmaking shops, however, are chemically unsuitable (e.g., too limey) for recovery as aggregate. At present they are disposed in a secure landfill (see section below on landfill). Although this disposal appears to be environmentally adequate, there is considerable pressure to reduce landfilling. When this production is consolidated in the proposed new POLDI 2 furnace, consideration should be given to some reprocessing. Slags could be segregated, crushed, and metallic values recovered. The residues should be evaluated for reuse, either as a lime source for some blast furnace or for incorporation into fertilizer. Economics of either reuse are very questionable. A secure landfill may be the best environmental solution for these materials.

b. Fly Ash and Cinders

As long as the main powerhouse burns pulverized coal, it will continue to produce fly ash and cinders. At present essentially all fly ash and cinders are trucked to a landfill in an abandoned quarry some distance from the plant. A small portion of the fly ash is sent to a cement plant for reuse. Management has reached a tentative agreement with a manufacturer of building products for the sale of a significant portion of the cinders for use in building bricks. Efforts should continue to increase the marketing of these materials to both the cement and building products industries. These uses are environmentally preferable to landfilling, which remains the only realistic alternative. When the proposed conversions of the boilers to gas firing is completed, no additional fly ash or cinders will be generated--the environmental benefits of conversion are great.

The second boiler house also produces cinders. These are used to fill in minor operations around the plant and are spread on icy roads to prevent skidding. Residual cinders are landfilled. This material is at times contaminated with heavy metals since the boiler house is used for burning miscellaneous wastes. Shutdown of this boiler house is essential and will eliminate environmental problems from this source.

c. Scale

Scale is recovered in scale pits at the many rolling operations at this plant. Scale is high in metallic values and its reuse is environmentally desirable. A portion of the scale is recovered and sold to blast furnace operators. A minor portion (mostly stainless) is remelted in POLDI furnaces. Some portion of the scale is so oily that it is unsuitable for reuse. Unused scale is currently landfilled. Landfill of this material is environmentally undesirable. Efforts should be made to increase sale of this material. If the proposed incinerator (see below) is installed, processing the oily scale in the incinerator will produce a product suitable for reuse in the steelmaking furnaces. This would be the best solution environmentally.

d. Spent Refractories

Spent refractories are a problem in all steel plants. POLDI has an extensive program for refractory reuse in corporation direct reuse and grinding for mortar and attempts to find other uses in building materials, selling some material for this purpose. Nonetheless, about half the refractories produced are landfilled. Considering the inert nature of these materials, landfill appears to be environmentally sound.

e. Sludge from Waste Water Treatment

The sludge produced from treatment of all plant waste waters is currently disposed of in the landfill with slags. Considering the high metals content of this sludge, Management proposes that this high moisture material will be processed in the incinerator with the residue to be remelted. Until that time, landfilling appears to be environmentally acceptable (see Landfill discussion below).

f. Grinding Wastes

A small quantity of potentially valuable waste is produced from grinding operations on stainless steel. This material contains a high percentage of valuable metallics but is badly contaminated with oils which prevent its reuse in the furnaces. Attempts to remove the oil by various physical and chemical methods have not been successful. At present this material is stockpiled for future use. The proposed incinerator will be able to process this material for remelting. Environmentally, that seems the best solution.

g. Miscellaneous Wastes

The plant produces a number of small waste streams which have either high organic content or high moisture which require some proper handling. These include such materials as oil recovered in the waste water treatment plant, packaging materials, rubber waste, sludges, etc. Many of these materials are burned with coal in the old boiler house. That entire operation is environmentally unacceptable. The incinerator proposed by Management is necessary to permit environmentally acceptable handling of these materials.

2. Landfill

In the past, landfilling has been the primary means of solid waste disposal of this plant. The principal land disposal area is Bustehradskahalda. There is at that area a mountain made up primarily of blast furnace slag. The larger part of this area is now closed. The closed pile has been completely covered with soil and recultivated. The recultivating can only be considered a complete success. Grasses and trees grow in profusion and there is evidence of an extensive population of wildlife (pheasants, rabbits, etc.). There is a collection basin for seepage runoff although none has been collected to date. An extensive network of groundwater monitoring wells shows no contamination of groundwater.

The adjacent area now used for landfilling of slag and sludge is very well managed. Walls are built above current dumping levels and are already recultivated. An extensive water spray system controls dust adequately. Groundwater monitoring shows no contamination.

Although Czechoslovakia law discourages landfilling and would lead to closure of this facility, it appears to be environmentally protective and could continue to provide secure disposal for materials for which no practical reuse can be developed.

3. Incinerator

Generation of oily wastes, combustible wastes, and high moisture wastes is inherent in any steel plant operation. Generally these materials are not suitable for land disposal because of their instability and potential groundwater pollution. In the past, POLDI has handled many of these materials by combining them with coal and burning them in the old powerhouse. This practice is environmentally very undesirable. Management has proposed the installation of a properly designed incinerator with good control of combustion, adequate segregation of combustion residues for reuse, and good air pollution controls. Proper operation of such a facility combined with the other programs discussed above, should provide environmentally sound handling of solid wastes at POLDI.

III. RECOMMENDATIONS AND CONCLUSIONS

The POLDI steel plant at Kladno has severe environmental problems with air pollution and solid waste handling. There are no easy low cost solutions to these problems. If this plant is to become environmentally acceptable, it must proceed with a program of rationalization and modernization that has been proposed by Management. Portions of this program essential to environmental acceptability includes:

- Improved air pollution control systems including canopy hoods for capture of emissions from furnace leakage, charging and tapping on upgraded electric furnaces at steelmaking shops in Drin and POLDI 2
- Shutdown of steelmaking shops at POLDI 1, and the "old" and "new" open hearth shops in the old works
- Conversion of the main powerhouse from coal burning to natural gas firing
- Shutdown of the old boiler house now used for combustion of wastes
- Installation of an incinerator properly designed to treat wastes and segregate residues for reuse
- Increased use of solid wastes for production of building products and other practical reuse
- Continued judicious use of landfills with adequate groundwater monitoring and protection

EXHIBIT 2

Plan of POLDI Plant
Kladno, Czechoslovakia

(Operations mentioned in report are identified by number on attached plan)

1. POLDI 1 Steelmaking Shop
2. POLDI 2 Steelmaking Shop
3. Old Works Old Open Hearth Shop
4. Old Works New Open Hearth Shop
5. Drin Steelmaking Shop
6. Main Powerhouse
7. Old Works Powerhouse
8. POLDI Works Powerhouse
9. To Bustehradskahalda Landfill
10. To Waste Water Treatment Plant

FIGURE I
POLDI STEEL PLANT
KLADNO, CZECHOSLOVAKIA
Water Flow Diagram

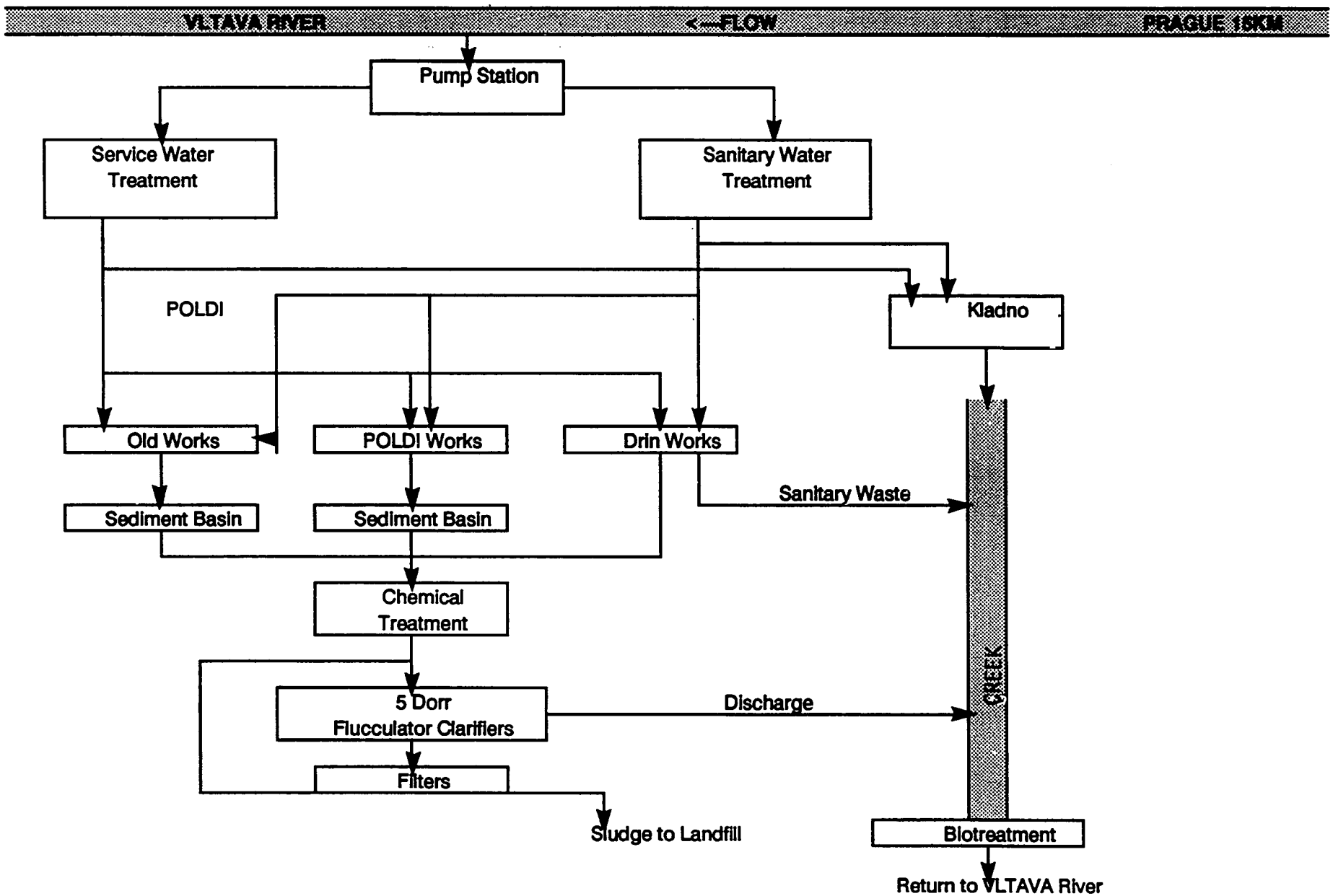

TABLE I

POLDI Plant - Kladno
Water Quality Data

	Service Water	Treatment Plant Feed	Treatment Plant Discharge	Permit Conditions
pH	7.6	7.5	7.5	6-8
Total Solids mg/l	298	500	533	800
Suspended Solids mg/l		60	73	
$B.O.D._5$ mg/l		7.7	2.7	13
Oil & Grease mg/l		3.5	.45	2.0
Organics (?)	8.7	60	24	20
Iron Fe mg/l	29	4.5	1.5	3.0
Sulphate mg/l	67	109	136	
Phenol		01	008	0.20

PERSONS CONSULTED

- Principal Contact:
  Ing. Vaclav Hromadka, odbor strategickeho planovani

- Translator and Principal Guide:
  Ing. Jaroslav Kotynek, technik

- Ing. Drobny, power plant

- Ing. Jiri Tomek, Director Engineering,
  Plant Division

- Ing. Veverka, water treatment

- Ing. Josef Hejduk, land disposal

AUTHOR

Earle F. Young, Jr., now retired, spent 25 years working full time on the environmental control aspects of the steel industry.

After receiving a B.S. in Chemical Engineering from Carnegie Institute of Technology in 1949, Mr. Young was employed by Jones & Laughlin Steel Corporation in 1956. After several years in research, primarily in raw materials processing, he was placed in charge of the corporation's environmental program in 1965. He guided that program until 1976, organizing the environmental department of the corporation, guiding the selection and design of facilities for air and water pollution control and solid waste management and negotiating permits with regulatory authorities. In that work he became fully familiar with the pollution problems and solutions for three integrated steel plants, a stainless melt shop, numerous finishing mills, coal mines and iron ore mines.

In 1976, he left J&L to join the American Iron and Steel Institute (AISI) as its chief environmental officer. He was responsible for liaison between the member steel companies and the U.S. Environmental Protection Agency, for dissemination of pollution control information among member companies and for management of the research in environmental control sponsored by AISI.

Mr. Young has served with the World Health Organization and the United Nation's Environmental Program in the development of background information and technical guidance relative to environmental control in the steel industry.