

MEMORANDUM RE: 23 G-134)
ELEKTROKEMISK ELECTRIC
SMELTING INVESTIGATION X
BENCH TESTS
OCTOBER 31, 1961

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MEMORANDUM RE:
ELEKTROKEMISK ELECTRIC SMELTING INVESTIGATION
BENCH TESTS

This memorandum covers Javelin's understanding with Elektrokemisk concerning "Bench Scale" tests to be conducted on Julian iron ore concentrates as part of Javelin's investigation of a Labrador steel plant. These tests are preliminary to the more extensive pilot plant smelting tests which it is agreed will be made at the earliest possible data, and which will be required to obtain data for a feasibility study on the proposed steel plant.

I. During the past few months representatives of Canadian Javelin and Elektrokemisk have discussed the use of an Elektrokemisk-designed electric furnace for production of pig iron in Labrador from Julian iron ore concentrates.

II. Professor H. U. Ross, of the Department of Metallurgy, University of Toronto, has been retained by Canadian Javelin to study and report on direct reduction processes applicable to production of pig iron and steel from Julian concentrates in a Labrador plant. He has been instructed, in view of Javelin's interest in electric smelting, to give particular attention to those processes in which electricity is used to provide the major portion of the heat required for smelting. He has participated in the discussions with the Elektrokemisk staff and has recommended that we proceed with preliminary "bench tests" to obtain technical data from which to estimate plant performance and capital costs for a plant using Elektrokemisk furnaces.

III. Those considerations which led to Javelin's decision to proceed immediately with these "bench scale tests" and to make arrangements for the pilot plant tests without waiting for the results from the initial tests are outlined below:

a) Javelin has previously run a pilot plant test on electric smelting of the Julian concentrates to produce pig iron and steel in the Strategic Udy pilot plant. Their work confirmed the technical feasibility of smelting the ore; however, this group has, up to this date, failed to provide Javelin with satisfactory preliminary estimates of capital cost and operating costs, based on this test.

b) Javelin has an urgent need for reliable data to back up its presentation of this project to the various governmental agencies, financial groups and customers who are interested in the project. These additional electric smelting tests appear to be the best means of obtaining plant data from which to prepare estimates that will stand up under the most rigid examination.

c) Javelin felt that Elektrokemisk was specially qualified to provide the technical and plant data required, as Elektrokemisk furnaces are today used to produce in excess of 1,000,000 tons of pig iron and ferro alloys annually. One plant in Norway produces 300,000 tons of pig iron per year, using Elektrokemisk furnaces and, through Elektrokemisk, design and operating data on this operation may be obtained for estimating the Labrador plant.

Elektrokemisk's wide experience in scaling up data from "bench tests" and "pilot plant" tests into commercial plants and this

successful record of commercial application of their furnaces would appear to leave little doubt that their estimates for the proposed plant would be realized when the plant comes into production.

d) For electric smelting of the high quality Julian concentrates, it appears that there will be relatively little variation in the cost of plant or product between the various electric smelting techniques. The basic chemistry of the process of producing iron from these concentrates is simple and straightforward. The absence of harmful impurities in the raw materials reduces problems in the electric smelting operation, to making the most efficient use of the carbon and heat required in the smelting process. Elektrokemisk has the engineering experience based on commercial plant design to achieve this economy.

e) Variations in the basic electric smelting process have been developed to overcome certain specific situations. These include special furnace designs and electrical systems (Udy patents and process), pre-reduction of furnace feed, and special "slag compositions" where it is necessary to remove harmful impurities. Few of these variations have found wide commercial application and, in the case of Julian concentrates which will be smelted with relatively low cost power, they appear to offer very little improvement over the electric smelting furnace as it is presently operated at the Mo i Rana plant in Norway. Provision for later use of these variations can be made in the plant, if this should appear advisable.

f) The decision to proceed with the investigation of an electric smelting plant in Labrador has been made on these considerations. The "bench tests" will be completed early in December, 1961, with the pilot plant tests tentatively scheduled for the latter half of January, 1962. Discussions of preliminary plant estimates and layout have already started between the Javelin group, as represented by Professor H. U. Ross, Kilborn Engineering of Toronto, and Elektrokemisk's staff. The details of a working agreement, covering the preparation of an estimate in U.S. or Canadian dollars, will be worked out within a short time.

IV. The following information and data is expected to be obtained from the "bench tests":

- a) Confirmation of the suitability of Julian specular hematite concentrates for electric smelting in the electric furnaces designed and sold by Elektrokemisk.
- b) Preliminary data from which to prepare estimates of plant and production costs.
- c) Data which will assure the Elektrokemisk staff that the project is based on sound technical assumptions and on which they can recommend that Javelin and Elektrokemisk proceed with the pilot plant tests and engineering studies necessary for a feasibility report.

V. The samples which Javelin proposes to supply for both "bench tests" and pilot plant tests are outlined below, together with Elektrokemisk's requirements for the proposed tests:

- a) For each one to be run through "bench tests", Elektro-

kemisk requires:

- 1) 50 lbs. of concentrates.
- 2) 20 lbs. of coal to be used in smelting.
- 3) Limestone or flux stone analysis and, where possible, samples.

b) In the general discussion of the smelting investigation, it has been agreed that "Wabush concentrates" and "Julian concentrates" can be considered as essentially one and the same for electric smelting purposes. It is proposed to submit a sample of each for "bench testing" to check this similarity and, following confirmation, use "Wabush concentrates" in the pilot plant run with which it is proposed to follow these "bench tests". This course is necessary because there is not time to mine Julian ore and produce the 125 tons of concentrates from it for pilot plant testing, as this pilot plant test is now tentatively scheduled for January, 1962. For the initial furnace run it has been decided that the course outlined will be taken as offering the best available means of obtaining the required information within the time allowed.

c) Samples of flux stone cannot be obtained; however, data on geological samples of a local dolomite have been submitted for consideration. Additional study of the flux supply will be required during and after the tests.

d) Samples to be shipped will be:

- 1) A 50 lb. sample of concentrates from Julian pilot plant tests.

2) A 50 lb. sample of concentrates from the Wabush concentrates stockpile.

3) A 40 lb. sample of coal from Dominion Steel & Coal Company. This coal has been discussed by H. U. Ross with Elektrokemisk and may or may not be suitable for use in the process. Samples are expected to arrive in Norway about November 5, 1961.

e) These first samples are essentially "grab samples" which are generally characteristic of the concentrates and coal which it is proposed to use in the plant. They have not been obtained through systematic sampling over any particular period or from any particular test. The material they were taken from was uniform in composition and no attempt was made, due to physical limitations, to confirm with any sampling pattern or procedure in obtaining these samples.

In the production of iron ore concentrates from either Wabush or Julian ore, a considerable variation can be obtained through plant procedures which could be used, within limits, to give concentrates with the most suitable iron-silica ratio for use in the electric smelting process. The mineralogical make-up of the concentrates would remain unchanged, i.e., they would be a specular hematite-quartz mixture in which screen analysis and ratio between iron and silica could be controlled, within certain limits.

VI. The detailed procedure followed in the "bench scale tests" cannot be outlined until after the samples are received at the laboratory for study and analysis. Elektrokemisk has had wide experience in this work and

these procedures have been left entirely in their hands.

The test procedures will give data on which to base an initial assessment of the following:

- a) The suitability of the Julian-Wabush concentrates for electric smelting in an Elektrokemisk-designed plant.
- b) The essential similarity between Julian and Wabush concentrates for electric smelting.
- c) The application of agglomeration processes to these concentrates and the recommendation of processes for agglomeration, prior to smelting.
- d) The application of pre-reduction and pre-heating in smelting of these materials.
- e) The application of Nova Scotia coal of the type submitted in electric smelting of these concentrates.
- f) Procedures for the proposed pilot plant run.
- g) Preliminary plant capacity and cost estimates on which to base a recommendation to continue the investigation into pilot plant and feasibility studies.

VII. Elektrokemisk is a technical organization which specializes in design of electric smelting furnaces and related facilities. It is understood that they will work with Javelin on feasibility and market studies, but that their policy is to confine their work to technical phases of plant construction and preparation of engineering estimates and technical data for use in such studies where their furnaces and processes are being studied.

Memorandums and reports, covering arrangements for the tests and the various phases of the test work and engineering studies, will be prepared during the course of this investigation to keep the groups associated in this work informed of progress on the project.

W. H. ROXBURGH

Dated: October 31, 1961.