THE MEHDIABAD BASE METAL PROJECT

Project Technical Summary
March 2005

Union Resources Limited
Brisbane, Australia

PROJECT SUMMARY

This report provides a summary on the progress of the Mehdiabad Zinc Project (the Project), effective March 2005.

The Project is located in Yazd Province in Central Iran and is operated as an incorporated Joint Venture (JV) through the private Iranian stock company Mehdiabad Zinc Company (MZC).

Union Resources Limited (UCL) is both a shareholder in MZC and the project manager. UCL partners in the Project are the Government of Iran (IMPASCO) and a private Iranian Company (Itok GmbH).

The initial focus of the JV was on the exploration of the Mehdiabad Deposit (the Deposit). This effort recognised an oxide deposit lying above the sulphides and significantly extended the sulphide mineralisation southwards. A Pre-Feasibility Study was conducted which demonstrated the viability of the oxide and sulphide deposit using open cut methods and on site zinc metal processing. In the last 12 months the Project has advanced to the Bankable Feasibility Study Stage.

Development of the Project is scheduled to commence next year with the construction of the mine and a 160,000 tpa zinc plant and with further expansion as the sulphide is exposed and mined production is planned to reach 500,000 tpa of zinc metal with lead concentrate production.

Mehdiabad is a giant Early Cretaceous carbonate hosted zinc-lead and silver deposit, occurring within a broad north-south orientated half graben. Outcrop occurs on the eastern side along East Ridge and is terminated at shallow depth on the western side by a major fault zone (Black Hill Fault). The central part of deposit is covered by thick alluvium.

The Deposit has been evaluated by more than 42,500 metres of diamond core drilling. The work has successful outlined an in ground zinc resource of 15.5 million tonnes of zinc, 5 million tonnes lead and 350 million ounces of silver, making the Project the largest undeveloped zinc resource in the world.

The resource is still open on the northern most drill section, over a width of 1300 metres and thickness up to 40 metres.

The Bankable Feasibility Study (BFS) is being undertaken by the major engineering firm Aker Kvaerner (Kvaerner). The BFS is expected to be completed by the end of 2005.

The Deposit will be mined by large scale open cut methods. The upper third of the Deposit comprises zinc oxide mineralisation and the lower two-thirds as sulphide minerals. Separate processing plants will be needed for the treatment of the oxide ore and the sulphide ore.

The first plant (Oxide Plant) will involve the direct acid leaching of the ore, with purification and recovery of the zinc metal by solvent extraction and electrowinning (SX-EW).

The second plant (Sulphide Plant) will be constructed around five years after the Oxide Plant and it will produce a zinc sulphide concentrate, which will be open tank acid leached to produce zinc metal at site. The Sulphide Plant will also produce a lead-silver concentrate for sale.

Fully developed the Project is capable of producing 6% of the world's zinc at relatively low cost. The Project is expected to produce 500,000 tonnes of SHG zinc metal and 180,000 tonnes of lead-silver concentrates.

MEHDIABAD JOINT VENTURE

The Project is operated as an incorporated joint venture through the Iranian private stock company Mehdiabad Zinc Company (MZC). The joint venture partners are Union Resources Limited (UCL) and Itok GmbH (combined 50%) and the Government of the Islamic Republic of Iran (50%). UCL is an Australian listed public company focusing on the Project.

The original owner was the Government of Iran through the Ministry of Mines and Industry. In October 1999 UCL and Itok signed a Foundation Agreement with the Government giving UCL and Itok the right to explore, undertake feasibility studies, and then to develop and exploit the Deposit.

In November 1999 a Joint Venture Agreement was signed between UCL, Itok and the Government company (now IMPASCO). Under this agreement IMPASCO was credited with an expenditure of US$10 million in recognition of past exploration and shaft sinking at the site. UCL and Itok agreed to spend a matching US$10 million on exploration and feasibility studies to earn a combined 50% interest in the project, (the Earn-In).

To date around US$7 million has been spend on exploration, metallurgical and various engineering studies and the BFS. The remaining Earn-In is expected to be completed in the next six months. After the Earn-In is completed, then IMPASCO must contribute or dilute their interest.

PROJECT LOCATION

The Project is located in central Iran, approximately 80 kilometres south east of the city of Yazd and approximately 550 kilometres directly south east of Tehran (see the map on the following page).

An Exploration Licence covering some 100 sq kms, held in trust for MZC by the Ministry under the Foundation Agreement, covers the Project.

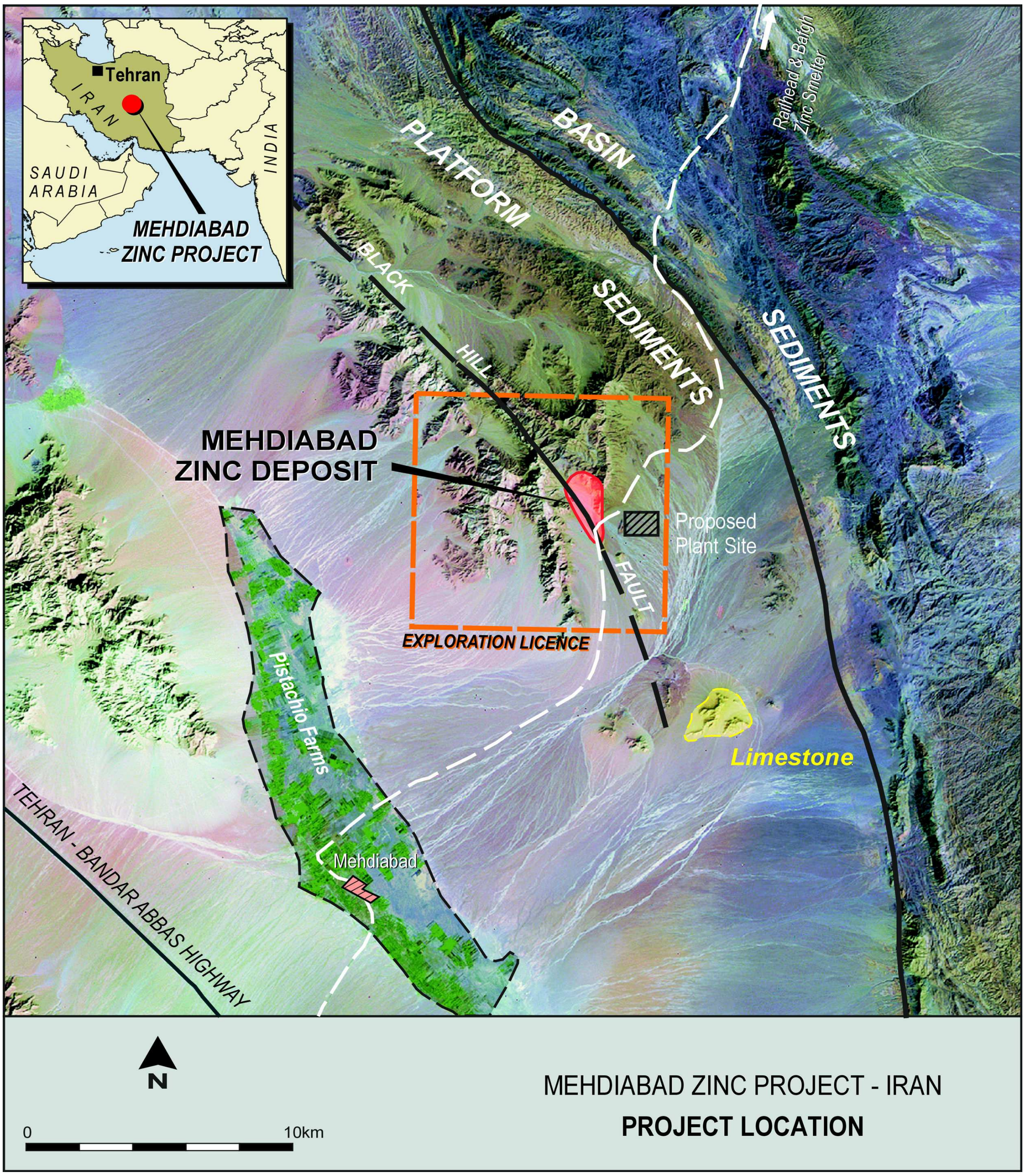

Figure 1: Mehdiabad Zinc Project – Location Plan

PROJECT HISTORY

Mining of hand picked ore by tunneling occurred along part of the eastern outcrop area of the deposit in the 1950's.

Drilling has been carried in five separate programs between 1963 and the present day, to total 42,538 metres. The current program is continuing and on completion around 50,000 metres will have been drilled.

Table 1: Drilling Activity

Period	By	No. of Holes	Length (m)
1963 – 1966	Mehshahr & Amax	9	1,944
1974 – 1977	Mehshahr & Mitsui	15	4,671
1985 – 1993	Ministry of Mines & Metals	42	16,940
2000 – 2001	MZC JV (Exploration drilling)	68	11,883
2004	MZC JV (In Fill resource upgrade drilling in progress)	37	7,835
Total		171	43,273

The Ministry of Mines and Metals have also sunk a vertical exploration shaft, designed to obtain bulk samples for metallurgical test work. This shaft commenced in 1993 and terminated at 325 metres in 2004.

At the end of the MZC JV Exploration Drilling, a pre feasibility study was carried out showing that it would be viable to mine both oxide and sulphide ore by open cut methods and extract the zinc by acid leach.

MZC was incorporated in July 2003 as the Project operating company and preparatory work for the bankable feasibility study was commenced. This work has involved the commencement of the "In fill resource upgrade drilling", extensive metallurgical test-work, plant flow-sheet design, open pit mine design and the development of an economics spreadsheet.

BANKABLE FEASIBILITY STUDY

Aker Kvaerner Australia (Kvaerner) commenced the BFS for both the oxide and sulphide plant in November 2004. Kvaerner is a major international engineering company with considerable experience in major resource projects in Iran.

The BFS is being executed from three main locations, Brisbane (Australia), Toronto (Canada) and Iran. The study is being managed from Brisbane in order to maximize client communication.

Kvaerner produced a major 270 page Status Report at the end of Phase II of the BFS in March 2005. Considerable progress has been made during phase II and the report details Kvaerner's strategy for achieving international standard BFS compliance on completion of Phase III.

THE EXISTING ENVIRONMENT

The Project is located within the Kalmand Bahadoran Protective Area predominantly covering the mountains to the west of the Deposit. In this area all fauna are protected from hunting under a decree made in 1991. Mining operations are permitted within the area.

The fauna protected includes the endangered Asiatic cheetah, leopard, desert lynx and the Blanford's fox, a number of bird and reptile species.

There is no unique flora in the area. There are no people or agricultural activities within the Exploration License.

Mehdiabad, the nearest village, is located about 20km south west of the Deposit. The main industry is pistachio growing with some 10,500 people involved in the general district and a total area of 120,000 ha under cultivated. There is also some wheat, dairy and poultry production.

The pistachios are irrigated by a series of 120 shallow water wells from an alluvial aquifer.

The major issue in the villages has been identified as:

(a) Shortage of water for agriculture
(b) Youth unemployment

The development of a mine at Mehdiabad will seek to rectify both these issues, whilst at the same time addressing world's best environmental practices.

The local people strongly support mining and are eager to see the Project come into fruition.

THE REGIONAL GEOLOGY

The Deposit is situated within the Central Iran Structural Unit where middle Jurassic deformation has resulted in regional unconformities, granite intrusions and local low-grade contact metamorphism.

The deposit is hosted by Lower Cretaceous carbonate formations at the boundary between a platform domain to the southwest and a subsidence basin of Cretaceous to Tertiary sediments to the northeast. The sequence lies transgressively and unconformably over a granite basement of Jurassic age.

The deposit occurs within a half graben occurring within a broad south draining valley flanked by higher mountains to the west and less prominent ridges to the east (East Ridge).

The deposit is bounded on the western side by the Black Hill Fault Zone (BHFZ) and on the eastern side by East Ridge. The Cretaceous beds typically dip at 45 degrees west at outcrop on East Ridge and flatten to 15-20 degrees west in the centre of the synform. In the centre of the valley Quaternary alluvium up to 150 metres thick overlie the Cretaceous beds.

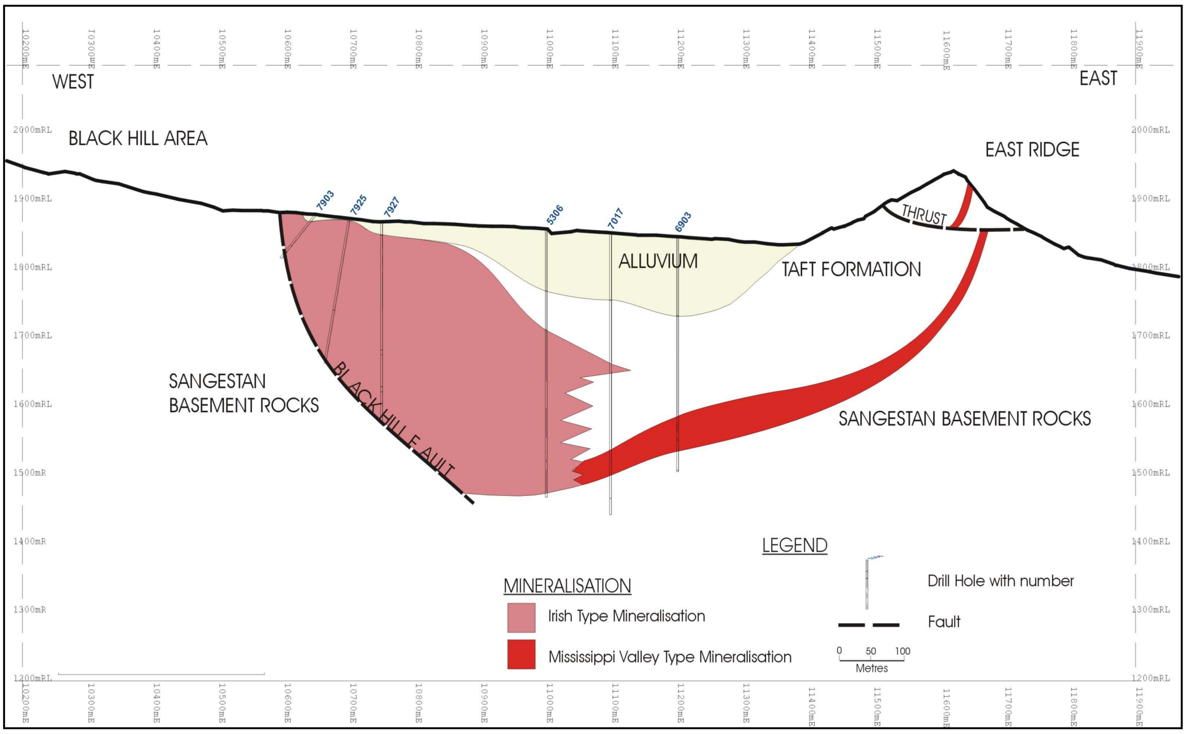

Figure 2: Geological Cross Section

Table 2: Stratigraphy

Age	Name	Type
Quaternary		Alluvium
Cretacous – Younger	Abkouh	
	Taft	**Mineralisation Host**
Cretaceous – Older	Sangestan	
Basement		Granite Region

MINERALISATION

Extensive dolomitisation and ankerite alteration of the Taft Formation host preceded the introduction of the sulphide mineralisation. This activity resulted in substantial rock volume reductions which was a later time invading by highly concentrated sulphide brines, possibility originating from the nearby basin and focused into the area by the Black Hill Fault Zone, (BHFZ).

Major sulphide minerals deposited within breccias and cavities with the dolomitic units and along the Black Hill fault were sphalerite (zinc sulphide) and galena (lead sulphide) with variable silver with minor pyrite, chalcopyrite and chalcocite.

Subsequent oxidation has resulted in the formation of the main oxide minerals smithsonite, hydrozincite, hemimorphite and cerussite.

The major gangue mineralogy consists of barite, dolomite, calcite, ankerite, siderite, iron oxides and minor manganese.

Mehdiabad is considered a hybrid carbonate-hosted deposit type that is characterised by a Mississippi Valley Type (MVT) tectonic setting, host-rock sequence and epigenetic ore textures and also by an Irish-type ankeritic alteration halo and mineralogy.

There are two main styles of mineralisation:

- Eastern: Typical MVT style. Stratabound Zn with low Pb, very low Ag, very low Ba and no Cu; and
- Western: Typical Irish style. Massive solution breccia style Zn in close proximity to the BHFZ. It has abundant Ba, higher Pb, high Ag and minor Cu.

THE RESOURCES

Prior to the commencement of the Joint Venture the Deposit was considered by the Ministry of Mines and Industry to be a small to medium lead and zinc sulphide occurrence extractable by underground methods.

However, the MZC exploration drilling increased the known resources around 400% over the previous drilling and focused the thinking towards open cut extraction.

Consequently the Iranian Geological Survey issued a new Discovery Certificate in November 2004 outlining the proven reserve under Iranian methods as:

Table 3: Iranian Discovery Certificate Resources:

Oxide Reserve	45,228,193 tonnes @ 7.15% Zn, 2.47% Pb
Sulphide Reserve	116,533,485 tonnes @ 7.3% Zn, 2.3% Pb
Barite Reserve	10,416,532 tonnes
Total	167,298,073 tonnes

At the end of the MZC exploration drilling program SRK Consulting undertook a JORC compliant resource estimate using a ‘nearest neighbour’ fill method, based on a pre-determined search ellipse.

Table 4: JORC Compliant Resource Estimates 2001
(cut off grade 4% Zn).

Resources Category	Tonnes	Zn %	Pb %	Ag g/t
Inferred	142,684,688	7.10	2.32	46
Indicated	75,165,938	7.38	2.38	62
Total	217,850,625	7.20	2.34	51

Based on this resource the Mehdiabad Deposit contains 15.6M t of zinc, 5.0M t of lead and 357M oz of silver.

The deposit is considered a super giant deposit ranking second in size between the Red Dog Deposit in Alaska (first) and the Century Deposit in Australia (third).

However, the Deposit is open to the north over a width of 1.3 kms with mineralisation thicknesses of 40 metres still present on the northern most drill section. To the south the Deposit is open over 250 metres. Therefore it may well be much larger.

A geo-statistical survey conducted in 2003 by Hellman and Schofield (H&S) using variography determine that drill spacings of 100 metres would give a Measured Resource, 150 metres an Indicated Resource and 200 metres an Inferred Resource. This study has been used as the basis for planning the MZC Infill drilling program currently in progress.

A further JORC complaint estimate of the resource will be made in the BFS report upon completion of the MZC In fill drilling program.

Geological and geo-technical logging of the diamond drill core is undertaken at the site. Sample preparation is undertaken at a laboratory in Tehran and final assay in Australia.

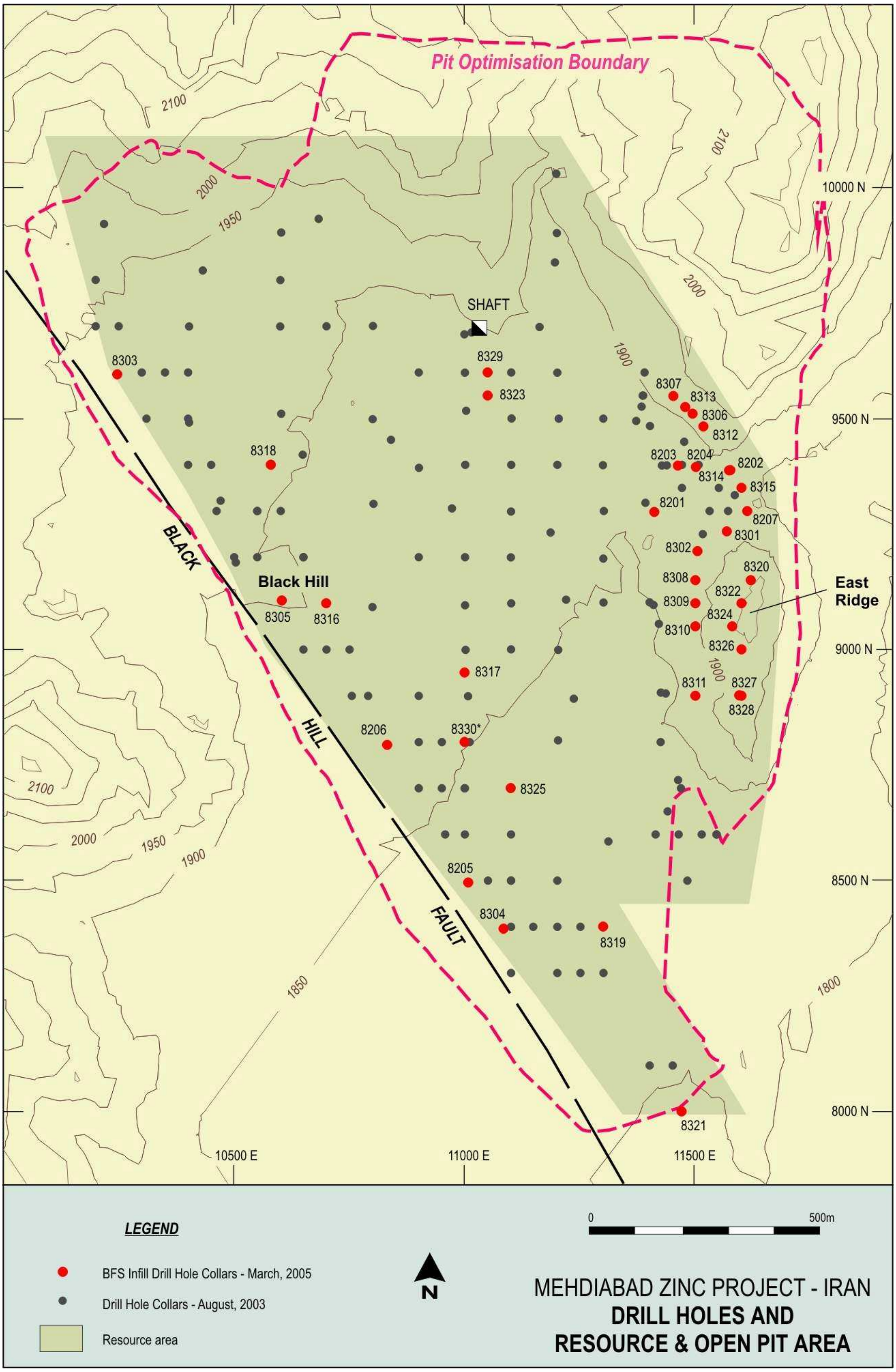

Figure 3 – Plan of Resources

OTHER RECENT SITE ACTIVITY

- **Trail Mining / Oxide Bulk Sample:** This has involved the excavation of two pits one on the western side of the ore body and one on the eastern side for the purpose of collecting representative samples for metallurgical testwork;

- **Sulphide Bulk Sample:** Collection of a bulk sample from sulphide ore collected from the shaft.

- **Geophysics:** Completion of orientation ground gravity and magnetic surveys as a possible tool to evaluate ('sterilise') proposed infrastructure and services sites;

- **Hydrology:** Casing of four drill holes for use as piezometer holes for an aquifer pump testing from the Shaft.

MINING

Mining will be conventional open pit methods utilizing large scale mining equipment.

Australian Mine Design and Development (AMDAD) using the Whittle Milawa program for an open cut mine, have prepared a preliminary life-of-mine (LOM) schedule.

The design suggests MZC can extract the following "In-Pit Resources", using a cut off grades were 2% Zn for the oxide and 3% for the sulphide.

Table 5: In Pit Resources

Oxide Reserve	90 million tonnes @ 5.1% Zn (2% Zn cut off)
Sulphide Reserve	159 million tonnes @ 6.2% Zn (3% Zn cut off)
Total	249 million tonnes @ 5.8% Zn

The in pit waste that has to be extracted would be:

Table 6: Waste Volumes (BCM)

Alluvium	74 million BCM
Rock	467 million BCM
Total	541 million BCM

The Strip ratio: 5.8:1.

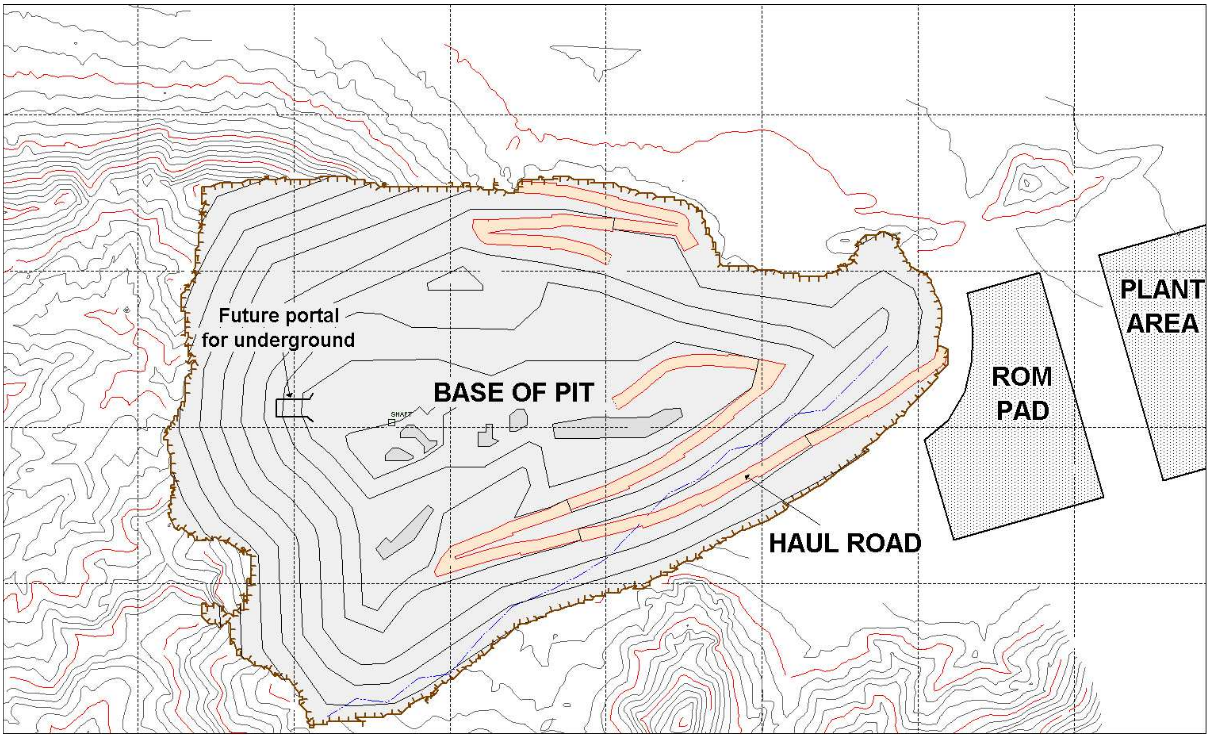

Figure 4: Simplified Version of Open Cut Mine Plan
(Showing haul roads & ROM PAD)

The production schedule will involve the mining of oxide ore from the first year and mining of sulphide ore commence in the fifth year. As the pit deepens the ratio of sulphide ore to oxide ore mined will increase. Similarly the strip ratio will be highest in the early years and will decrease as the mine matures.

Excavation will be by large electric-powered rope shovels or diesel-hydraulic face shovels and ore mining will be by diesel-hydraulic face shovels or excavators. To achieve moderate waste to ore mining ratios, the deposit will be mined by a number of staged pits.

The mining will be conducted by contractors. The maximum contractor fleet is expected to comprise.

Table 7: Major Equipment required at Yr 8 (100mtpa)

Equipment Type	Number	Capacity
Drilling	3	270-311mm
	2	115-140 mm
Loading	3	4050 t/smu
	1	3100 t/smu
	1	1700 t/smu
	3	1000 t/smu
Trucks	22	315 tonnes
	7	145 tonnes
Total Mining	42	

The total mine operating cost is expected to be around US$1 per tonne after allowing for the depreciation of the mine fleet.

The key geotechnical feature is the Black Hill Fault, which will have to be excavated and the western wall located in the more stable Sangestan basement rocks. The southern wall will be founded partly in alluvium, elsewhere the pit is expected to be founded in stable Sangestan.

The projected open cut mine life is 30 years. The final pit is expected to measure 2.5 kms in length, be 1.5 km wide and 400 metres deep, making it one of the world's largest pits.

After completion of the open cut mine, considerable ore will remain to the north of the pit. This ore is likely to be mined by underground methods, from a decline access extending northwards from the deeper portions of the open cut.

The underground resource may well extend the life of mine considerably, dependent upon how much ore lies to the north of the known resource, under the mountains.

WASTE DUMP DISPOSAL

The waste dumps are expected to be located to the east of the mine. It is planned to co-dispose dewatered plant residues and tailings with the waste rock from the pit.

HYDROLOGY

The Project is located in an arid environment. All water required will need to be taken from aquifers in the region. The village aquifer used for pistachio farming will not be used. There are two other aquifers available for use.

(a) Mine Area

The Taft Formation, comprising porous dolomite with caverns and solution cavities is the most important aquifer at the mine site. Water from the existing shaft can be pumped at a rate of approximately 45 L/s. The aquifer is believed to cover an area of 25 km^2.

(b) Hassan Abad Aquifer

The Hassan Abad aquifer located 65 kms from Mehdiabad, is likely to be the most important long-term water supply for the Project. This aquifer may be capable of supplying 270 L/sec to the Project from a combination of deep (up to 111 m) and semi-deep (up to 28 m) wells, springs and qanats (up to 71 m deep).

The Hassen Abad aquifer is considered suitable for reverse osmosis treatment. A treatment plant will be constructed at the Bore field to reduce costs prior to pumping to the Project. It is estimated that three transfer pumps will be required to convey the water to the plant.

MINERALOGY

Mineralogical studies have been conducted by Central Mineralogical Services (Adelaide, Australia) using thin sections, standard mineralogical methods and XRD.

Zinc occurs as oxides, carbonates, silicates and sulphides.

The major zinc minerals are shown in the following table:

Table 9: Zinc minerals

Mineral	Comment	Composition
OXIDES/ CARBONATES		
Chalcophanite	Oxide, Variable Crystallinity	$ZnMn_3O_7.3.H_2O$
Fraipontite	Very soft, inadequately known	$Zn_8Al_4(SiO_4)_5(OH)_8.7H_2O$
Hemimorphite	Silicate/oxide mineralisation, Also known as Calamine	$Zn_4Si2O_7(OH)_2.H_2O$
Hydrohetaerolite	Oxide	$Zn_2Mn_4O_8.H_2O$
Hydrozincite	Carbonate	$Zn_5(CO_3)_2(OH)_6$
Smithsonite	Carbonate	$ZnCO_3$
SULPHIDE		
Sphalerite	Sulphide	ZnS
Willemite	Silicate, rare at Mehdiabad	Zn_2SiO_4
Woodruffite		$(Zn,Mn)Mn_3O_7.1\text{-}2H_2O$
Wurtzite	Same composition as Sphalerite but different crystallinity. Regarded as low temperature, unstable form which reverts to Sphalerite	ZnS

Lead occurs mostly as galena in both the oxide and sulphide mineralisation, although occurrences of carbonate (cerussite) have been detected.

Metallurgical testing shows that zinc can be recovered from all ore types. However, lead and silver can be recovered only as a concentrate from the sulphide ore.

The Deposit is also considered to be the largest deposit of barite in the Middle East, which can be mined and used to manufacture drilling muds for the oil industry.

METALLURGY SUMMARY

The metallurgical test-work indicates that the zinc oxide ore and the sulphide concentrates can both be processed by using acid leach technology. The recovery of zinc from whole oxide ores using acid leaching and solvent extraction is a recent development in the zinc industry.

Table 10: Metallurgical Recoveries Expected

Metal	Ore Type	Flotation Recovery	Overall
Lead	Sulphide	77%	77%
Zinc	Oxide	-	75%
Zinc	Sulphide	80%	75%

PRODUCTION SUMMARY

The development of the Mehdiabad Zinc Project will involve the ramp up of zinc production from an initial level of 160,000 tones per annum to 500,000 tonnes per annum over a period of around 10 years. The plan is to produce SHG zinc on-site from both the oxide and sulphide ores.

The following preliminary schedule does not include the treatment of the lower grade zinc oxide material (2% to 4% zinc) initially stockpiled in the earlier years of mine production. Treatment of this material maintains a consistent 500,000tpa of zinc metal while the oxide ore is being treated.

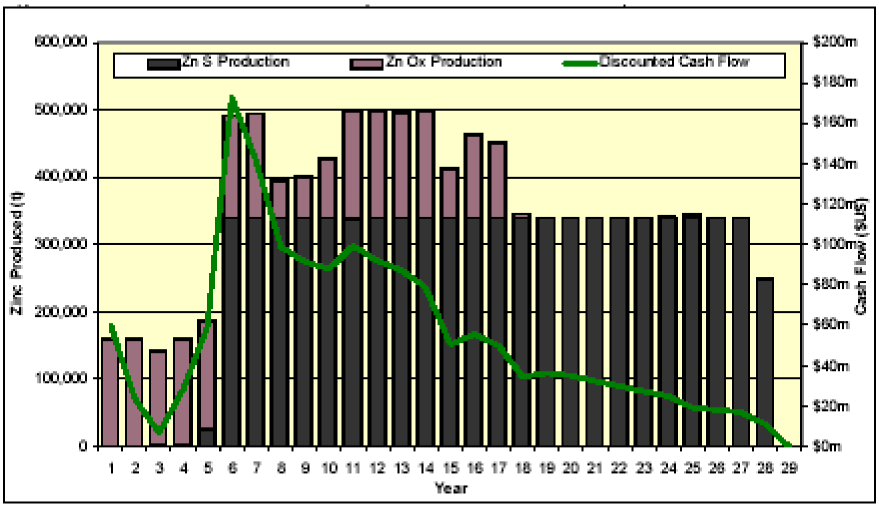

Figure 5 – Metal Output for Combined Oxide/Sulphide operation.

The proposed development steps are as follows:

- Year 1: 160,000 tonnes per annum zinc metal plant to process oxide ore (**Oxide Plant)**.
- Year 5: Commission 340,000 tonnes per annum zinc metal plant to process sulphide concentrates **(Sulphide Plant)**.
- Further refinement of the production schedule may incorporate an interim step of 160,000 tonnes per annum **(Stage 1 Sulphide Plant)** followed in Year 9 by 180,000 tonnes per annum expansion of the **(Stage 2 Sulphide Plant)**.

The Oxide Plant will require an ore feed rate of approximately 4 Mt/a, based on an ore grade of 5.8% zinc.

The Stage 1 Sulphide Plant will require an ore feed rate of approximately 4 Mt/a at a grade of 5.5% Zn ramping up to in excess of 8 Mt/a when the second Sulphide Plant comes on line.

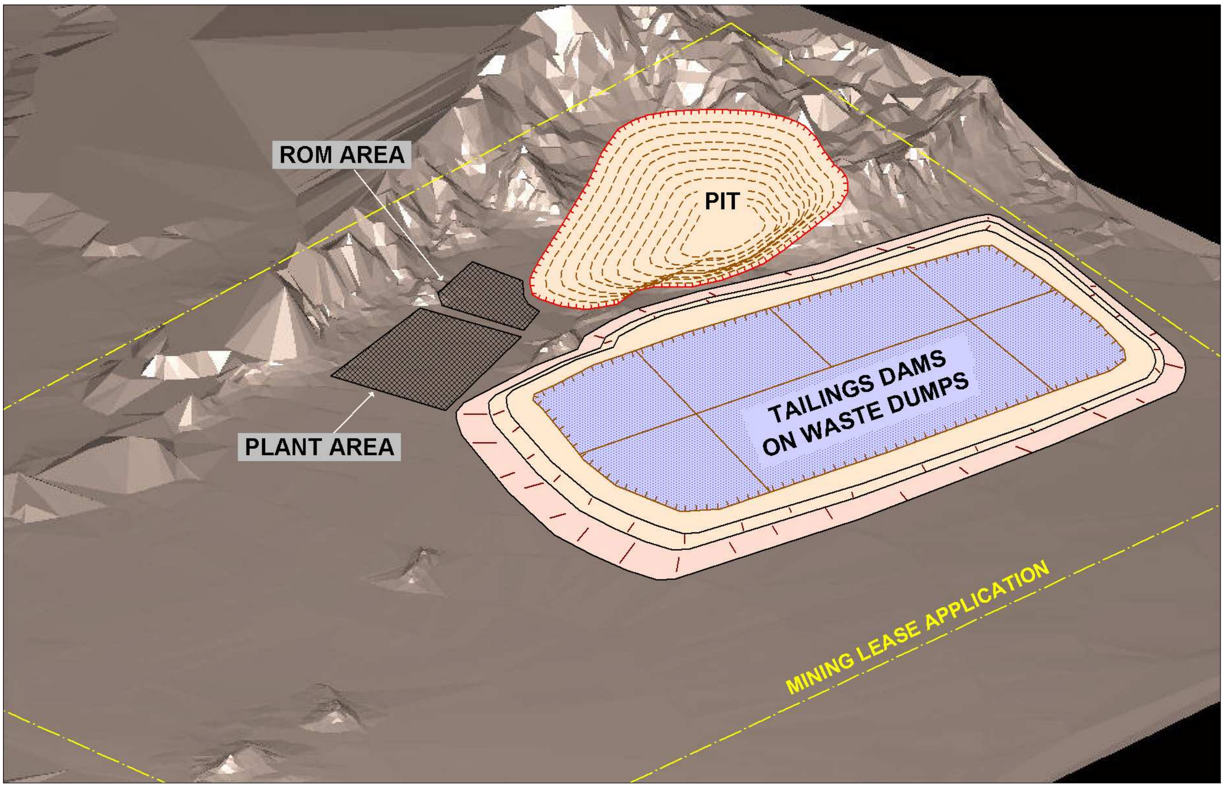

Figure 6: Site Layout

OXIDE ORE: METALLURGY

The leaching characteristics of the zinc oxides present over the Deposit is variable, with recoveries ranging from 65-85%. However, in the leaching process some unwanted minerals (contaminants) including manganese, magnesium, iron, chlorite, silica, copper, cadmium, nickel and cobalt are also leached out. The contaminants have to be removed from the leachate before the zinc can be recovered by electrowinning. The process of removal of the contaminants is referred to as purification.

There were available two alternate methods of purification of the leachate.

- **Zinc Dust Precipitation:** Commonly used in zinc refineries for purification of the leachate.

- **Solvent Extraction (SX):** A relatively new method successfully used at Anglo American's Skorpion Mine in Namibia.

Aker Kvaerner has recommended the application of the SX technology for the oxide ore.

OXIDE ORE: PILOT PLANT TESTING

Now that the purification process has been selected the pilot plant test work can be conducted. The pilot plant samples are ready and the tests will occur at the TR facility in Spain commencing in April 2005.

THE OXIDE PLANT

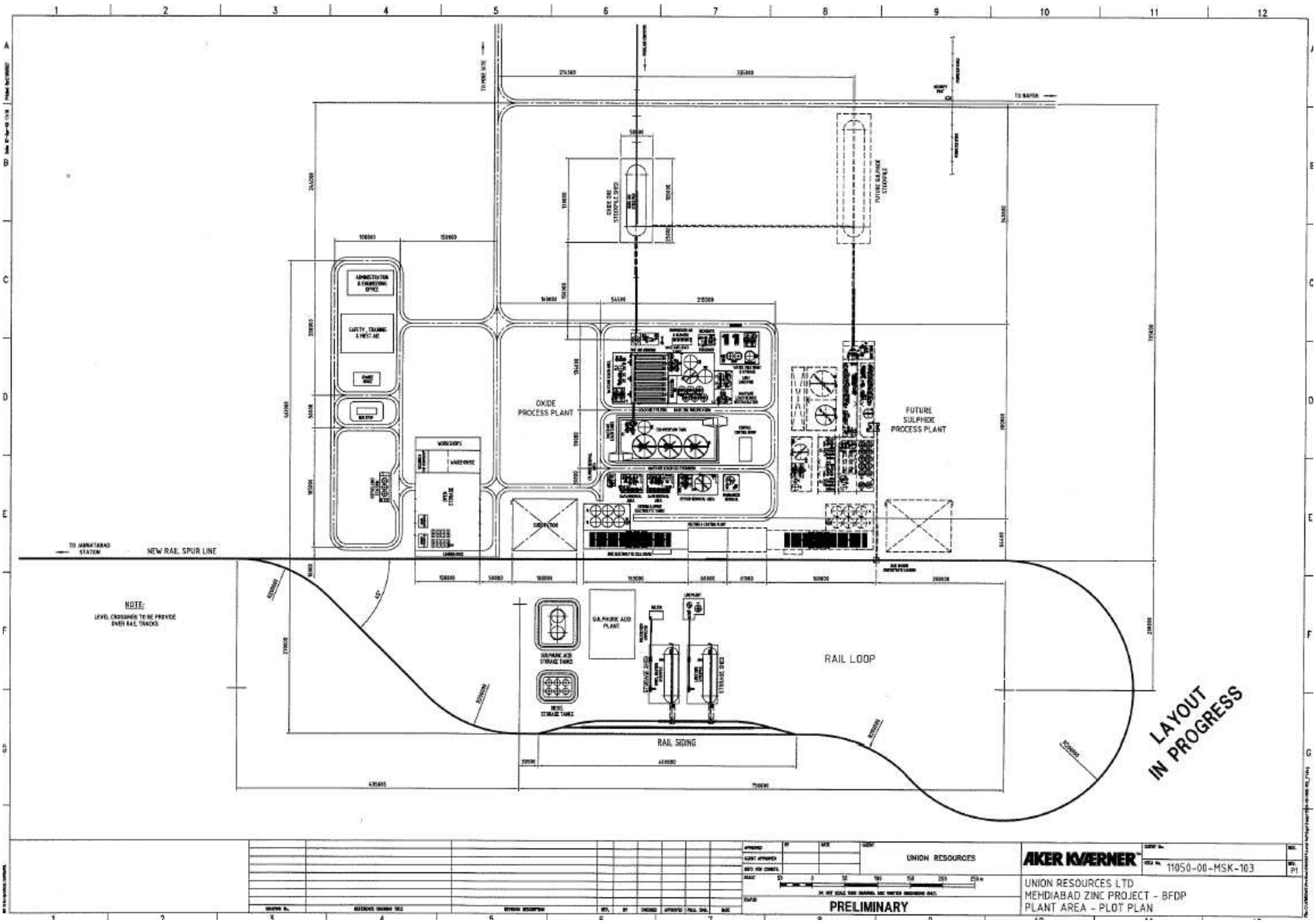

Figure 7: Oxide and Sulphide Plant Layout

The principal steps in the Oxide Plant are as follows:

(a) Crushing and Grinding

The crushing section is expected to include:

- Primary Crusher: One 420 t/h primary jaw crusher.
- Crushed ore stockpile.

The coarse crushed ore will be fed into an AG mill. The desired particle size of the ground ore is a P_{80} of about 180 microns.

(b) Counter-Current Leaching

The ground ore will be feed into the counter-current leaching tanks where it will be leached in two stages at 50^0C. At the end of both stages the leachate will be directed to a thickener.

(i) First Stage Neutral Leach: The Neutral Leach will be operated initially at an acidic pH (pH 1.5) and will then be neutralised to pH 4.2 to 4.7 through the addition of additional oxide ore. The neutralisation will precipitate iron, arsenic, antimony, silica and germanium.

(ii) Second Stage Acid Leaching. The underflow from the Neutral Leach will be leached at an acidic pH of about 1.0 to 1.5.

(c) Leach Residue Filtration

The underflow from the Acid Leaching will be pumped to a bank of nine 200m^2 horizontal belt filters. Leach residue from the filters will be sent via conveyor belt and fed into a re-pulp tank, where it is mixed with a portion of the liquor from the final neutralisation stage.

The filtrate from the first three filters will be returned for use in the Feed Thickener; the filtrate from the second three filters will be used as the wash liquor in Neutral Leach and the filtrate from the last three filters will be used as the wash liquor in Acid Leach.

(d) Solution Clarification

The Neutral Leach thickener overflow will pass through three pinned bed clarifiers, polishing filters and a bank of sand bed clarifiers to remove all traces of solids contamination and to produce a clarified solution. The clarified solution will contain about 35 g/L zinc and, possibly, the same amount of manganese.

(e) Solvent Extraction

Solvent extraction consists of three extraction stages, three scrubbing stages and two stripping stages, which collectively purify and concentrate the zinc to produce a suitable electrolyte feed to the zinc cellhouse. In addition, there will also a single depletion stage that extracts the remaining zinc from cellhouse solution returned to the solvent extraction circuit (raffinate).

(f) Raffinate Treatment

Treatment of raffinate will remove any contaminants returning to the solvent extraction circuit from the cellhouse.

(g) Electrolysis

In the cellhouse, the strong electrolyte containing about 90 g/L zinc and 110 g/L acid is mixed with the spent electrolyte from the cells containing 50 g/L zinc and 170 g/L acid to produce a cell feed solution containing 55 g/L zinc and 162.5g/L acid.

The cellhouse is expected to comprise 84 cells in two rows of 42.

(h) Melting and Casting

The cathodes from the cellhouse will be melted and cast into special high grade (SGH) ingots.

(i) Acid Plant

A sulphur-burning acid plant is required to provide 93% concentration sulphuric acid for the Oxide Plant. The plant will export 12 MW of electrical power net after internal consumption and it will consume approximately 80 m^3/h of treated water.

SULPHIDE ORE: METALLURGY

The sulphide metallurgical testwork has been conducted at Optimet Laboratories in Adelaide using composites from different parts of the ore body.

The results showed that the galena and sphalerite are amenable to beneficiation by flotation, albeit with some variability across the ore body, which seems to be dependent upon the amount of iron-zinc carbonate mineral present.

The results show that galena can be beneficiated into a contemporary commercial quality concentrate. The optimum grind size was found to be 75 µm P_{80} grind size, where 90% of the galena and sphalerite were reported as free liberated mineral.

A satisfactory grade of lead concentrate can be produced for sale to lead refineries.

The zinc concentrate target grade of 35% to 40% to maximize recovery is suitable for acid leaching in open agitated tanks with oxygen.

Leaching of the sulphide concentrate has shown extraction of the zinc in the high 90's from the concentrate.

Atmospheric direct leaching of zinc sulphide concentrate with sulphuric acid is now regularly used by major zinc producers as a means of increasing zinc production at existing zinc plants without the necessity of concentrate roasting.

THE SULPHIDE PLANT

For the first ramped sulphide expansion of 160,000 tpa zinc.

(a) Crushing and Grinding

The jaw crusher is equipped with a 400 kW motor and set to produce a product of 80% passing 150 mm.

The primary SAG mill will be of 8.6 m diameter by 4.3 m long SAG mill driven by a 4500 kW motor.

The secondary grinding mill will be a 6.7 m diameter by 8.6 m long ball mill driven by a 6500 kW motor.

(b) Lead Flotation

The lead flotation circuit will be designed on the basis of an overall recovery of 75% to a final concentrate grading 60% lead. The circuit will be conventional with roughing, scavenging, a regrind of the scavenger concentrate and two stages of cleaning.

Lead concentrate will be thickened and filtered before storage, from which it will be shipped.

(c) Zinc Flotation

The zinc flotation circuit will be designed for the maximum recovery and to this end will produce a concentrate grading 38% zinc at a recovery of 80%. The circuit will consist of a conventional roughing and scavenging section. The scavenger concentrate will be reground and cleaned. The zinc rougher concentrate and the scavenger cleaner concentrate will be combined to produce the final concentrate. This concentrate will then be further ground in horizontal stirred mills before thickening.

(d) Leaching

The oxidative leach and purification circuit will operate on the basis of a 95% extraction of zinc from concentrate. There are eight leach tanks and two iron precipitation tanks in a continuous train, followed by a separate neutralisation stage. The leaching plant is sized to produce 170 000 t/a of zinc feed to the purification stage, comprising 160,000 t/a slab zinc and about 10,000 t/a recycled material.

All tanks will operate at atmospheric pressure. The leaching stage will operate auto-thermally at 95°C – 110°C. The majority of the acid required in the leach will be provided in the spent electrolyte.

(e) Goethite Precipitation

The leach stage will be followed by a goethite precipitation stage, which will remove most of the iron and acid and convert the iron and other impurities into a solid form for disposal to tailings.

(f) Zinc Dust Purification

Elements harmful to the zinc electrowinning process will be removed in a two-stage zinc dust purification circuit. The first purification stage precipitates the copper, cadmium, cobalt and nickel by the addition of zinc dust, copper sulphate (if required) and potassium antimony tartrate. The second zinc dust purification stage, which acts purely as a clean-up stage.

(g) Electrolysis

The purified solution is pumped to the cellhouse and mixed with spent electrolyte and fed to the electrolysis cells. The zinc is deposited on the cathode sheets and every 48 hours the zinc is stripped from the cathodes for melting and casting.

(h) Melting and Casting

The cathode zinc sheets are fed to the single melting furnace and they are melted and cast.

INFRASTRUCTURE

(a) Power Supply

The project will require reliable power supplies to support an estimated 100 MW during commissioning rising to 160 MW from years 1 - 6 and 260 MW from year 7 onwards. It will require the construction of a 45km transmission line to the project site

(b) Roads

The route to Yadz will bypass the villages and require the upgrade and sealing of an existing 46 km section of gravel road. Total distance from Yazd is 91 km.

(c) Rail

It is expected that rail transport will be the primary transportation method for the import of process materials and the export of products.

The most suitable route for the rail spur line to the main Tehran to Bandar Abbas Line is a distance of 60 km. The rail distance from Project site to Shahid Rajaee Port near Bandar Abbas is 624 km

(d) Port Facilities

Shahid Rajaee Port is fully equipped as a modern port with sufficient capacity to handle the inbound capital equipment needed and also to handle the export of zinc ingots and the lead-silver concentrates.

(e) Tailings

Clarifier underflow will be pumped to the tailings disposal system for disposal in containments constructed within the waste dumps.

(f) Other Infrastructure

Procedures on safety, fire control, health, workshops, water management and staff facilities have been prepared and are considered the industry standard for a major mining and processing plant.

(g) Central Workshops

Workshops will be constructed at the site to handle all major repairs and maintenance for the mining and processing equipment.

(h) Warehouse

A major warehouse complex will be constructed for all consumables, materials and machinery parts including special areas for the storage of flammable and dangerous goods and the storage of zinc ingots and lead-silver concentrates awaiting shipping.

(i) Local Industry Support Facility

An area of land to be set aside for the establishment of industrial sheds by appropriate private Iranian companies, particularly those whose products or equipment are employed on the project.

(j) Personnel Transportation

On site accommodation will be limited with buses of appropriate sizes and condition being provided to carry personnel to and from work and their designated pick up and drop off points.

(k) Water Borefield Facilities

The facilities at the bore field will comprise an osmosis treatment plant, control room and workshops to maintain the pumps.

ECONOMICS

(a) OXIDE PLANT: CAPITAL COST ESTIMATE

The capital cost for the Oxide Plant based on all new equipment quotations from leading suppliers.

Table 11: Oxide Plant Capital Costs

Item	**USD**
Process Mechanical Equipment	157 million
Commodities	146 million
Acid Plant	51 million
SX Plant inventory	1 million
TOTAL OXIDE PLANT CAPITAL COST	**355 million**

(b) OXIDE PLANT: OPERATING COST ESTIMATE

Key points:

- An estimated staff of 492 people will be required to run the Oxide Plant.
- The plant will meet all environmental standards.
- The oxide plant will require the following key consumables:

	Tonnes/annum
Sulphur	172,544
Limestone	167,040
Lime	86,400

Table 12: Total Plant Operating Cost

Item	**USD/a**
Labour	6 million
Reagents and Consumables	20 million
Maintenance Supplies	11 million
Electrical Power	14 million
TOTAL	**50 million**

(c) SULPHIDE PLANT: CAPITAL COST

Including crushing, concentrator, zinc plant and infrastructure per 160,000 tpa zinc production module (2 ultimately required).

TOTAL SULPHIDE PLANT CAPITAL COST: US$256 MILLION PER STAGE.

(d) SULPHIDE PLANT OPERATING COST

(i) **Labour:** The number of personnel for supervision, operations and maintenance is estimated to be 133 people.

(ii) **Reagents and Consumables:** The major reagents and consumables are:

Table 13: Major Consumables Per Stage

Item	**Per Annum**
Sulphide	22,691 tonnes
Limestone	63,068 tonnes
Lime	1,489 tonnes
Mill Balls	2,660 tonnes
SAG Mill Balls	1,140 tonnes

ECONOMICS REVIEW

A review of the project economics by UCL at the end of Phase 2 of the BFS suggests that the total operating cost will be around US$600 per tonne of zinc metal produced.

The project NPV at current zinc prices is above US$1000 million. The IRR is close to 30%.

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