Statement of Basis
for a
Draft Permit and Proposed Aquifer Exemption

BHP Florence Project
Class III In-Situ Production of Copper
February 1997

Location

The proposed copper mine would be located 2.5 miles northwest of the Town of Florence, Arizona. The mine would lie within Township 4 South, Range 9 East, Sections 27, 28, 33, and 34 in Pinal County.

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I. Purpose of Statement of Basis

Pursuant to 40 CFR 124.7, the purpose of this Statement of Basis is to briefly describe a) the derivation of the conditions of the draft permit and b) the reasons for these permit requirements. To meet these objectives, this Statement of Basis contains background information on the permit and aquifer exemption process, a description of the facility, and a discussion of the permit conditions.

II. Permit and Aquifer Exemption Process

Application and Review Period

In accordance with Underground Injection Control (UIC) regulations, codified at Title 40 Parts 124, 144, 146, 147 and 148 of the Code of Federal Regulations, BHP Copper of Tucson, Arizona filed an application with the United States Environmental Protection Agency (EPA) on January 19, 1996 for a Class III area permit and an aquifer exemption for the purpose of in situ copper production. The administrative review of the application package was completed in February 1996. Between February 1996 and October 1996, EPA conducted a technical review of the application. In November 1996, EPA completed a draft Class III area permit. The draft permit contains numerous construction, testing, monitoring and restoration requirements and defines the lateral and vertical boundaries of the proposed aquifer exemption.

Technical Review

The technical review of the permit application was conducted by engineers and hydrogeologists in the EPA, Region 9 office in San Francisco. Additionally, the groundwater modeling portion of the BHP application was reviewed by scientists at EPA's National Risk Management Research Laboratory in Ada, Oklahoma. The scientists at the Ada lab were utilized because a) they were familiar with the groundwater modeling software used by the applicant and b) they had staff who were familiar with the hydrogeology of this region in Arizona.

Consultations

Pursuant to 40 CFR 144.4(b) and Section 106 of the National Historic Preservation Act, EPA has consulted with the State Historic Preservation Officer (SHPO) and the Advisory Council on Historic Preservation (the Advisory Council) regarding the preservation of cultural resources at the proposed mine site. To create a mechanism to investigate and resolve any cultural resource issues in an appropriate manner, EPA, SHPO, and the Advisory Council signed a Programmatic Agreement with concurrence from BHP Copper, the Gila River Indian Community, and the Hopi Tribe. BHP Copper has completed a Cultural Resource Management and Treatment Plan which has received concurrence from all member agencies of the Programmatic Agreement.

Pursuant to 40 CFR 144.4(c) and Section 7 of the Endangered Species Act, EPA has consulted with the United States Fish and Wildlife Service (USFWS) and the Arizona Game and Fish Department (AGFD) regarding potential biological impacts from the construction and operation of the proposed facility. Based on a biological evaluation of the proposed site (SWCA, Inc., July 1995) and consultations with USFWS and AGFD, no significant impacts are anticipated. However, BHP Copper will implement a Wildlife Monitoring Plan (Appendix H of the draft permit) to document that the facility does not jeopardize the continued existence of any endangered or threatened species or adversely affect its critical habitat.

Coordinated Permitting Effort

Since the Arizona Department of Environmental Quality (ADEQ) has an aquifer protection program but has not received primacy for the federally-administered UIC program, BHP has undergone a dual ADEQ-EPA permitting process. While the EPA technical review and draft permit focus on the subsurface (i.e., injection and restoration activities), the state's review and permit will cover both subsurface activities and the surface facilities and impoundments. The provisions of the two permits provide comprehensive coverage over all facets of the in-situ mine operations that have the potential to impact the quality of underground drinking water supplies. EPA and ADEQ have worked together to ensure that the two permits are consistent and have decided to continue this coordinated effort by combining the federal and state public participation processes.

Public Participation

Pursuant to 40 CFR 124.10, the public shall be given at least 30 days to review and comment on draft permits and at least 30 days notice of a public hearing. Pursuant to 124.10(b)(2), the draft permit and public hearing notices may be combined. Since the aquifer exemption is part of a permitting action, the exemption proposal is considered "minor" and EPA may conduct the same public participation procedures as apply to the permitting action (49 FR 20143). In a letter dated August 29, 1986 (GWPB Guidance #34) from the Director of the Office of Drinking Water to the Director of the Water Management Division Region 5, it was determined that the authority to approve or deny "minor" aquifer exemption requests had been delegated to the Regional Administrator. Furthermore, in December 1996, the authority to approve minor aquifer exemptions was delegated from the Regional Administrator to the Water Division Director.

In accordance with the above requirements, the draft EPA permit and the proposed aquifer exemption have been combined into one public participation process. The draft permit and this Statement of Basis will be made available at ADEQ, Water Protection Approvals and Permits Section (3003 N. Central Avenue, 4th Floor, Phoenix, AZ 85012) for a 30-day comment period. The public will be notified of this 30-day comment period and a public hearing scheduled at the end of this comment period by publication of a notice in the following local newspapers: the Florence Reminder-Blade Tribune and the Tri-Valley

Dispatch (Pinal County). In addition to the news releases, key interested groups will be notified by direct mail. Notices will be sent to adjacent land owners, local community leaders, including the Florence Area Chamber of Commerce and the Town Council, and some civic groups that BHP met with prior to submitting the application.

III. Facility Information

The Ore Body and the In Situ Approach

The BHP-Florence proposal involves the production of copper from an ore body that is located 2.5 miles northwest of the Town of Florence, Arizona. In the plan view, the targeted ore body covers approximately 250 acres. The recoverable copper is located between 400 feet and 1600 feet below ground surface in a highly fractured, copper oxide bedrock formation. The ore body is located in the saturated zone as the water table is approximately 130 feet below ground surface.

The BHP-Florence proposal would recover copper by the construction of injection and recovery wells. A sulfuric acid solution would be injected into the ore zone, copper would be solubilized (i.e., moved from a solid state to a dissolved state), and the copper-laden solution would be pumped out via surrounding recovery wells. Compared to open pit mining, this in situ (or "in place") approach has some of the following benefits: 1) major groundwater de-watering efforts are not required, 2) water quality in the mining zone can be restored to adequately protect surrounding ground water, 3) by avoiding major excavations, particulate matter (dust) impacts are less significant, 4) after closure, aesthetic impacts are relatively insignificant, and 5) copper ore bodies which are low grade or are fairly deep may be economically recovered. Although there are many advantages to in situ mining, since the mining zone cannot be visually observed, groundwater modeling and monitoring must be emphasized in order to verify that surrounding groundwater is not endangered.

Facilities and Impoundments

In addition to injection and recovery wells, the project would include the construction, operation, and eventual closure of surface facilities and impoundments. The proposal includes raffinate impoundments and processing facilities for the injectate (a dilute sulfuric acid solution), a pregnant leach solution (PLS) impoundment for the copper-laden solution recovered from the subsurface, a solvent extraction/electrowinning (SX/EW) plant, surface run-on/run-off facilities, an evaporation impoundment, a non-storm water containment impoundment, and ancillary facilities according to the design and operational plans approved by the Arizona Department of Environmental Quality (ADEQ), Aquifer Protection Permit Program

Section. The surface facilities and impoundments would cover approximately 180 acres and would be located immediately east of the 250-acre mine site.

As summarized below and described in the August 1996 final draft Arizona Mining BADCT Guidance Manual, the Florence Project's operation relies on engineered controls and operational procedures to demonstrate Best Available Demonstrated Control Technology (BADCT)

Tanks and ancillary components used in the SX/EW processing plant will be located in concrete-lined areas. All tanks and pipelines, electrowinning cells, vessels, mix tanks, and solids separation equipment will be located above ground in such a manner as to be easily inspected for leaks by visual means. Stormwater will be captured and will either be used for process make-up or sent to the evaporation impoundments. The plant spill control and run-off impoundment is designed to handle 110 percent of the largest vessel in the SX/EW plant and to contain the quantity of water expected to be collected during a 100-year, 24-hour storm event. Contained spills will be returned to the process or directed to the evaporation impoundment.

The PLS and raffinate impoundments will share a common wall and are located west of the SX/EW plant area. They will be equipped with two 60-mil high density polyethylene (HDPE) liners and a Leachate Collection and Recovery System (LCRS). The evaporation impoundment will have eight operating cells and one standby cell. Four additional cells have been planned in case they are needed during the life of the project. Each cell will be equipped with two 60-mil HDPE liners and a LCRS. The spill control and run-off impoundment serving the SX/EW process area will have a 60-mil HDPE liner on top of a concrete liner. All impoundments are located outside the 100-year floodplain and are designed to maintain a minimum 2-foot freeboard while operating at maximum design capacity and simultaneously experiencing a 100-year, 24-hour storm event.

The In-situ Mine Area

Over the projected 15-year mine life, the operator would construct approximately 3,000 injection and recovery wells within the 250-acre mine zone boundary (Appendix A, Figure 1). The mine area will be divided into discrete mining units. Injection will proceed unit-by-unit until mining of the entire permitted area has been completed.

Aboveground pipelines set in surface trenches constructed with impermeable liners will transport the raffinate (i.e., the injection fluid) from the SX plant to the in situ mine area. Prior to injection, the pH of the raffinate will be adjusted by the addition of sulfuric acid. The sulfuric acid tanks will be constructed aboveground in a bermed containment area lined with acid-resistant material. The sulfuric acid tank containment area will be constructed to contain 110 % of the capacity of the largest tank in addition to the run-on from a 100-year 24-hour storm event. To prevent any of the aboveground tanks from emptying into the in situ well field during a power outage, all tanks

within the in situ tank farm will be constructed with "normally closed" valves. After pH adjustment, the raffinate will be pumped to headers (manifolds) for injection into the oxide formation beneath the site.

Injection will typically occur throughout screened intervals of 200 feet to 400 feet in length at depths from 400 to 1,600 feet below ground surface. Recovery wells will be constructed 50 feet to 100 feet from the injection wells and will be screened throughout the same zone as the injection wells. The recovery wells will pump copper-enriched injection fluids (PLS) from the in situ mine to pipelines feeding the PLS pond.

To prevent the *lateral* migration of mining fluids into or between underground sources of drinking water, hydraulic control over the injected solutions will be maintained during the operating life of the mine. The rates of injection and recovery will be continuously monitored and controlled so that the total volume of solution recovered will be greater than the volume of solution injected, averaged over 24 hours. Automatic controls and alarms will be used in the well field to ensure that process upsets do not result in the loss of hydraulic control. Hydraulic control will be confirmed by the use of production observation wells located on each side of an active mining block, or a combination of active mining blocks. The operating heads of the recovery wells and observation wells will be continuously monitored to ensure that an inward groundwater gradient is being maintained.

To prevent the *vertical* migration of mining fluids into or between underground sources of drinking water, a pre-operational corehole abandonment program will be implemented in accordance with rules of the Arizona Department of Water Resources (ADWR). The program will ensure that all coreholes located within 500 feet of all injection/recovery wells are properly abandoned (plugged and sealed) before injection/recovery wells are used for mining operations.

Once mining operations have been completed within a block, the mining block will be rinsed with fresh formation water to a level that meets Aquifer Water Quality Standards (AWQS) and Primary Maximum Contaminant Levels (MCLs) pursuant to 40 CFR 141. After confirming that the water in the mining zone meets AWQSs and MCLs, all injection and recovery wells in the mining block will be abandoned in accordance with the regulations of the ADWR and the Well and Corehole Abandonment Plan submitted with the UIC application.

IV. Permit Conditions

Area Permit

Since the operator is proposing to construct approximately 3,000 injection/recovery wells, EPA is proposing to issue the permit on an area basis. Pursuant to 40 CFR 144.33, the operator would be

allowed to construct injection and recovery wells only within the approximately 250-acre area that lies above the targeted ore body. This permitted area is within Township 4 South, Range 9 East, Sections 27, 28, 33, and 34 in Pinal County, Arizona. The boundary of this permitted area (i.e., the "mine zone boundary") is delineated and defined in Appendix A, Figure 1 of the UIC permit.

Aquifer Exemption

The total dissolved solids (TDS) concentration of the groundwater in the proposed mining zone ranges from 350 mg/L to 700 mg/L. The TDS concentration of the formations above the proposed mining zone ranges from 300 mg/L to 3,900 mg/L. The proposed mining zone and the overlying formations have TDS concentrations that are well below 10,000 mg/L and are therefore underground sources of drinking water (USDWs) as defined under 40 CFR 144.3. In order to mine the copper oxide zone, BHP Copper would have to meet the criteria for an aquifer exemption and receive approval from EPA. Pursuant to 146.4, the proposed operation meets the criteria for an aquifer exemption because 1) the aquifer does not currently serve as a source of drinking water and 2) it has been demonstrated by the permit applicant to contain minerals that are expected to be commercially producible. In order to adequately protect surrounding drinking water and in accordance with 40 CFR 144.7(b)(1), EPA has established both lateral and vertical limits to the proposed aquifer exemption.

Under permit condition II.B.1.a, the lateral aquifer exemption boundary is defined in the plan view as 500 feet beyond the mine zone boundary. This lateral aquifer exemption boundary was defined after reviewing hydrogeologic information submitted by the applicant. The position of this line was intended to protect surrounding drinking water sources, while giving the permittee a reasonable opportunity to correct any unplanned migration of injection fluids through the activation of contingency plans. The water quality monitoring wells will all be placed within this 500-foot interval, i.e., between the mine zone boundary and the aquifer exemption boundary. If an excursion is detected, the permittee will have the opportunity to avoid noncompliance with the permit by immediately activating a contingency plan and thereby preventing the migration of injection or formation fluids beyond the aquifer exemption boundary. If the permittee detects an excursion and does not reverse/correct the excursion as outlined in the permittee's contingency plans, the permittee will be in noncompliance with the UIC permit and subject to enforcement action under the Safe Drinking Water Act.

Under permit condition II.B.1.b, the vertical aquifer exemption boundary is defined as 200 feet above the oxide zone, or the base of the Middle Fine-Grained Unit (MFGU), whichever is further below ground surface. The groundwater table is approximately 130 feet below ground surface (bgs) and the producible ore is located at depths of approximately 400 feet to 1600 feet bgs. The vertical limits established in the permit allow BHP Copper to extract the targeted ore while protecting the upper zones, i.e., the upper basin fill unit (UBFU), the middle fine-grained unit (MFGU), and the lower basin fill unit (LBFU), which do not contain commercially-producible quantities of copper.

Under permit condition II.B.2, during the 15-year mine life, the permit requires that there is "no migration" of injection fluids, process by-products, or formation fluids beyond the 3-dimensional exempted zone. Since the movement of even one atom of injection fluids, process by-products, or formation fluids beyond the exemption boundary would be considered migration and a violation of the permit, during the 15-year mine life, the permittee must maintain hydraulic control by creating a hydraulic sink at the mine site. Since the permittee will be creating very high metal concentrations in the exempted zone during mining, the no migration requirement is considered appropriate in order to adequately protect surrounding drinking water sources. This no migration requirement is in accordance with 40 CFR 146.32 as "all new Class III wells shall be cased and cemented to prevent the migration of fluids into or between underground sources of drinking water."

The "no migration" requirement (permit condition II.B.2) only applies to the 15-year mine life, when hazardous constituents are at very high concentrations within the exempted zone and the permittee is actively maintaining hydraulic control. After the 15-year mine life, it will not be feasible to restore the exempted zone to background levels or maintain hydraulic control. Therefore, natural groundwater gradients will cause residuals from the mining activity to spread beyond the exemption boundaries. 40 CFR 144.12 prohibits injection activities from allowing the movement of any contaminant into underground sources of drinking water, if the presence of that contaminant may cause a violation of any primary drinking water regulation under 40 CFR 142 or may otherwise adversely affect the health of persons. Therefore, pursuant to 40 CFR 144.12, the permit requires (II.B.3 and II.I) that after the completion of mining activities within a block, BHP Copper shall restore the exempted zone such that the zone meets primary MCLs and would not otherwise adversely affect the health of persons. Restoring the exempted zone to primary MCLs and to a state that would not otherwise adversely affect the health of persons, is considered to be both "necessary and feasible to insure adequate protection of USDWs" (40 CFR 146.10). Proper restoration shall be verified by meeting MCLs at all monitoring wells throughout the 30-year post-closure period (II.F).

It is important to note that the UIC Class III Plugging and Abandonment regulations (40 CFR 146.10) have been changed with respect to "no migration." When the UIC regulations were first promulgated, Class III operators were held to "no migration" during mining operations (40 CFR 146.33) *and after plugging and abandonment* (40 CFR 146.10). In 1981, it was recognized that due to hydrogeologic gradients and the inability to economically remove all mining residuals, the "no migration" standard under 40 CFR 146.10 should be modified. As proposed in 1981 (46 FR 48246) and finalized in 1982 (47 FR 4993), 40 CFR 146.10(d) was changed from "no migration" to one of "adequate protection." As stated in the Federal Register (46 FR 48246), " the 'adequate protection' standard is intended to require all efforts on the part of the operator that are necessary to assure that there will be no movement of fluids into an underground source of drinking water so as to create a significant risk to the health of persons...in establishing specific requirements, EPA [headquarters] expects the Director [regional office] to take the particular circumstances of the

mining site into account--for example, the nature and concentration of the residuals, the hydrogeology of the aquifer, the economic and technical feasibility of cleanup actions, the importance of the aquifer, the proximity of water wells, and the number of people relying on the USDW down-gradient from the mining site."

In summary, by requiring "no migration" during mining and the return of the exempted zone to MCLs after mining, EPA feels that surrounding USDWs will be adequately protected.

Well Construction

The injection well casing string shall always be cemented to at least 40 feet below the top of the copper oxide formation unless written approval is received from the Director to expand the injection interval. Based on the results of computer modeling, requiring cementing to at least 40 feet into the oxide zone was considered a fairly conservative estimate to ensure that mining fluids would not contaminate the Lower Basin Fill Unit (LBFU). Any relaxation of this 40-foot requirement would require 1) a demonstration by the operator that injection wells could safely inject at a lesser depths, and 2) written approval by the Director. A demonstration to change the 40-foot requirement would most likely require both field data and computer modeling. The field data may include sampling of the LBFU.

Due to the low pH and high sulfate concentration of the injectate, the permit requires that the cement used to construct the wells is both acid resistant and sulfate resistant. Based on the physical and chemical strengths of Type V Portland cement, BHP is required to use Type V cement or demonstrate that an alternative cement has similar characteristics.

If the permittee chooses to rely on cementing records and a monitoring program to verify Part II of the mechanical integrity requirement (40 CFR 146.8(a)(2)), the permit requires that the monitoring program utilize annular conductivity devices. The probes would be placed in the cemented annulus within the Middle Fine Grained Unit (MFGU). By taking monthly measurements and comparing background conductivities with operational conductivities, a lack of vertical migration adjacent to the well bore can be demonstrated. At the time of this permit application, the annular conductivity test had only been demonstrated on a research level. Therefore, formal mechanical integrity Part II approval from the Administrator was not pursued. Instead, in accordance with 40 CFR 146.8(c)(4), the conductivity tests are considered to be a part of the monitoring program.

Correction Action

During exploration, BHP drilled approximately 400 coreholes into the ore body. The corehole abandonment plan is aimed at ensuring that these coreholes do not act as conduits during injection activities. Pursuant to 40 CFR 146.6, BHP submitted a zone of endangering influence analysis to EPA. The analysis showed that plugging all coreholes within a 500-foot radius of injection

wells would safely prevent vertical pathways into overlying underground sources of drinking water.

Well Operation

The well operation section of the permit details the mechanical integrity testing program, the maximum pressure limitation, and the injection fluid limitation.

Pursuant to 40 CFR 146.8(a)--Mechanical Integrity Part I, BHP will pressure test all injection and recovery wells prior to use and every 5 years. Pressure testing will ensure that 1) the injection fluids are entering the formation at the proper depths (i.e., 40 feet below the top of the oxide formation) and 2) copper-laden mining fluids are not leaking into the upper formations. Pursuant to 40 CFR 146.8(b)--Mechanical Integrity Part II, BHP will rely on cementing records and a monitoring program to demonstrate that fluids do not migrate vertically through channels adjacent to the well bore. As discussed above, BHP has enhanced the monitoring program with respect to mechanical integrity Part II by installing conductivity probes in the cemented annulus. Since the mining fluids have much higher conductivities than the natural formation water, vertical migration in the cemented annulus could be detected by comparing background conductivities with operational conductivities.

BHP has measured a fracture gradient of 0.65 psi/ft of depth, measured from ground surface to the top of the injection interval. This fracture gradient will be used to calculate the maximum pressure for each injection well.

During mining, the injectate will consist of a dilute sulfuric acid solution with a pH of approximately 2. During closure/restoration, the injectate will consist of fresh water and/or fresh water with neutralizing agents, such as, sodium carbonate.

Monitoring Program

The Florence Project would monitor the following: groundwater quality, hydraulic control, annular conductivity, and the injectate/raffinate characteristics. The permittee would also monitor two existing mining shafts to ensure that the shafts do not act as conduits for the vertical migration of mining fluids.

Thirty-one (31) groundwater quality wells have been drilled and screened over variable depths (Appendix A, Figure 3). The wells are mainly downgradient on the western and northern boundaries of the mine site. To ensure that any excursion of mining fluids is detected, the wells are screened within all water-bearing formations, i.e., the Upper Basin Fill Unit, the Lower Basin Fill Unit, and the Copper Oxide formation (the mining zone). Wells have also been placed near major faults in order to monitor preferential pathways. Level 1 constituents, such as sulfate and

fluoride, are very mobile and not easily attenuated. Level 1 constituents are considered excellent indicator constituents and are therefore monitored on a quarterly basis. Level 2 parameters would be sampled every 2 years and consist of a complete list of all constituents expected in the exempted zone.

Hydraulic control will always be monitored and regularly reported in quarterly reports. During the 15-year mining period, the permittee is required to create a slight regional sink such that groundwater always flows towards the mine site, and never away from the mine site. Hydraulic control will ensure that hazardous constituents are confined to the exempted zone. The permittee has proposed the use of 4 pairs of wells to monitor inward gradients (east, west, north, and south pairs on the edges of each mining block). In order to verify that this 4-pair arrangement will safely monitor hydraulic control over the 15-year mine life, the permittee is required to conduct a 90-day demonstration in which all wells on the perimeter of the first mine block are used to monitor hydraulic head and conductivity.

There are two old mining shafts in the northeastern corner of the mine site. The two shafts are not expected to be within the area of influence for most of the mining life, however, when these shafts are within 500 feet of any injection activity, the permittee will pump the shafts to create inward gradients. The inward gradients will ensure that fluids in the shafts do not contaminate surrounding zones. Furthermore, the permittee will demonstrate through monthly conductivity monitoring that mining fluids do not go above the oxide formation within the mining shafts. The reason for this requirement is that the integrity of the shafts is unknown and mechanical integrity tests are not feasible. Therefore, to ensure that mining fluids do not go beyond the aquifer exemption boundary, the mining fluids within the shafts must be kept within the oxide zone.

Contingency Plans

The permit has contingency plans for groundwater quality exceedances and the loss of hydraulic control. The contingency plans are aimed at protecting groundwater quality while giving the permittee a reasonable length of time to fully correct any excursion and/or loss of hydraulic control. The aquifer exemption boundaries are established such that the permittee may typically avoid noncompliance with the permit if the permittee takes immediate action and successfully corrects any unplanned excursions.

Restoration and Plugging & Abandonment

As detailed in the permit, pursuant to 40 CFR 141, 144.12, and 146.10, after mining a block, the permittee is required to return the zone to primary MCLs. Restoration to MCLs will ensure that the exempted zone does not endanger surrounding USDWs.

Post Audits

During the 3rd and 5th years of mining, post audits are required on the computer modeling which predicted the fate and transport of pollutants discharged by the Florence Project. These audits are considered necessary due to the inherent uncertainty with computer modeling. Specifically, the permittee should verify that neglecting agricultural recharge was a reasonable assumption.

Financial Assurance

BHP Copper submitted a statement of financial responsibility (dated Sept. 24, 1996 and signed by John T. Perry, Vice President of BHP Copper Company) to EPA for the Restoration and Plugging and Abandonment requirements outlined in Section I of the permit. BHP is required to maintain the financial capability to meet all subsurface closure costs throughout the life of the project. BHP has also established financial responsibility with ADEQ for the closure and reclamation of the surface plant and facilities.