MJW CORPORATION

Radiological and Health Physics Consulting Services

May 16, 1996

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New York State Department of Environmental Conservation
Division of Solid and Hazardous Materials
Bureau of Pesticides and Radiation
50 Wolf Road
Albany, NY 12233-7255

Subject: Transmittal of Work Plan to Support Additional Undeveloped Property Investigation

Dear Dr. Merges:

Enclosed please find one (1) original along with two (2) copies of the subject document which responds to the NYSDEC letter of March 11, 1996 to TAM Ceramics, Inc. and provides information relative to the concerns raised by NYSDEC regarding waste material discovered during site assessment activities on undeveloped property owned by TAM.

Should you have any questions about the enclosed material, please contact Mr. Russell Steiger, Manager, Health Safety & Environmental at (716) 278-9423.

Very truly yours,
MJW Corporation Inc.

David A. Dooley, Ph.D., CHP
President

DAD:lc

Enc.3

cc: Mr. Russ Steiger, TAM Ceramics, Inc.
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Work Plan for the Characterization of Material Containing Trace Amounts of Naturally-Occurring Radioactive Constituents Located on Undeveloped Property Owned by TAM Ceramics, Inc.

May 16, 1996

By

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1.0 Introduction

1.1 General

This work plan has been prepared to address concerns raised by the New York State Department of Environmental Conservation (NYSDEC) regarding waste material discovered during site assessment activities on undeveloped property owned by TAM Ceramics, Inc. This work plan will briefly describe the site, provide a site history, discuss TAM's New York State Department of Labor Radioactive Materials License and the site assessment and associated remedial work that's been performed to date on TAM's undeveloped property. Lastly, the work plan will discuss the steps TAM plans to take to address DECs concerns.

2.0 Site Description and History

2.1 General

This section presents an overview of the TAM Ceramics Site, provides a history of the facility, discusses TAM's NYSDOL Radioactive Material License and finally describes actions taken to date with regard to site assessment and associated remedial work performed upon TAM's undeveloped property.

2.2 Site Description

The TAM Ceramics Manufacturing Site occupies approximately 30 acres at 4511 Hyde Park Boulevard, in a commercial area of the Town of Niagara. The facility is located immediately south of the Hyde Park Landfill Superfund Site, and approximately 0.4 miles east of the Niagara River. The location of the facility has been previously described in the March 1995 report of Blasland, Bouck & Lee, Inc. entitled "Site Characterization Program Final Report" (BB&L, 1995).

The developed portion of the site occupies approximately 19 acres and consists of approximately 18 buildings on the west side of the Site dedicated to the manufacture of ceramic products. The remaining 11 acres of the site are undeveloped. This investigation will focus on the undeveloped portion of the Site. The focus area within the undeveloped portion of the site includes the area around Test Pit 12(TP-12), along the fence line approximately 200 feet north and south of TP-12 and as far as 150 feet west of the fence near TP-12. The focus area is thus approximately 60,000 square feet. A Site Plan detailing the site layout and showing in good detail the focus area has also been previously presented as Figure 2-2 of BB&L, 1995.

2.3 Site History

The facility was first owned by Titanium Alloy Manufacturing Company (TAMCO). Production operations began at the facility in 1906. The first product was high carbon ferrocarbon titanium which was used by the steel industry as a deoxidizer in the production of rail steel. In 1915, a sulphate process was developed using ilmenite ore, for producing titanium dioxide (TiO_2). The Titanium Pigment Company was formed as a subsidiary of TAMCO, and began operation as a manufacturing plant for titanium dioxide.

Titanium and zirconium metals were first produced by TAMCO at the facility in 1918. Experimental work on zirconium products began in 1914, and by 1919 a zirconium opacifier was produced. Milled zircon (zirconium silicate) ore was also produced and distributed from 1921 to 1937.

In 1920, NL Industries bought half of the Titanium Pigment company from TAMCO and acquired the balance in 1933. NL Industries acquired TAMCO in 1948. NL Industries continued the same types of manufacturing operations at the facility. A summary of the manufacturing processes and products produced by NL Industries is presented in Table 2-1 (BB&L, 1995) which has its source the Interagency Task Force on Hazardous Waste questionnaire from the 1979 report.

In 1979, NL Industries sold the facility to TAM Ceramics, Inc. (TAM), a division of Cookson International. TAM Ceramics continues to produce ceramics and ceramic-products. A summary of manufacturing process and products produced by TAM is presented in Table 2-2 of BB&L, 1995.

2.4 National Lead Site Radiological Survey 1979

In May of 1979 as a prelude to the sale of the property to TAM Ceramics, Inc., NL conducted an extensive site survey to determine the radiological status of the site. In summary, test pits were dug to or just below ground water level in 8 areas of the site with soil materials being collected and analyzed. Radon levels were also measured as were direct radiation levels. The results of these analyses show that no radiological material was present in the test pit areas and that the radon readings and direct radiation readings of the undeveloped property did not exceed background levels. In 1983, the Nuclear Regulatory Commission's review of this work concluded that no radiological hazard existed and that the site was therefore eligible for unrestricted release.

2.5 TAM's NYSDOL Radioactive Materials License

In 1989 a new High Purity Zirconia (HPZ) process being developed at TAM Ceramics, Inc. was identified as having the potential to produce a waste product containing naturally occurring uranium and thorium in a combined concentration approaching 0.11 weight per cent (w/o) or 1100 ppm. A uranium plus thorium concentration greater than 0.05 w/o or 500 ppm is defined as source material under federal and state regulations and as such is subject to federal regulations contained in 10 CFR 40 and equivalent New York State (NYS) regulations 12 NYCRR 38. Since it was apparent that TAM would have to deal with this new waste product under New York State regulation because of the fact that New York is an NRC agreement State, TAM proceeded to prepare an application for a Radioactive Materials License to the NYS Department of Labor. In the process of preparing the application for the proposed HPZ facility a significant amount of testing and analysis was performed on the naturally-occurring uranium plus thorium content of existing TAM raw materials and product and with regard to thc radiological conditions within the existing plant.

A complete radiological survey of the TAM processing facility was performed in March of 1989, (Dames & Moore, 1989). This survey included direct radiation measurements, air samples and radon concentration measurements. In summary, this report showed that direct radiation levels varied from background to 0.22 mrem/hr on contact with a 50 pound bag of product stored on pallets in the facility warehouse. General area dose rates in traffic areas approximated background areas where 6,000 pound hoppers of raw material were stationed or where other large piles of material were present. Dose rates of 2 to 8 times background were measured within a few feet of the material, with levels quickly dropping to background beyond this distance. Dust levels in the plant were not sufficient to warrant routine radiological monitoring of personnel. Measured radon levels approximated background for all measurements. The Dames & Moore survey did not measure radiation levels on or near the undeveloped property, or any other areas outside the manufacturing facilities.

The results of the above radiological surveys and the anticipated waste to be produced were then used to formulate the radiation protection program requirements of the TAM radioactive materials license application. TAM submitted their license application in January of 1991 with a Radioactive Materials license being issued on March 11, 1991.

Since the time of the original license application and license issuance TAM has placed the HPZ project on "indefinite hold" thereby negating the original need for the radioactive materials license. Therefore, TAM's present business does not use or produce licensable materials. What TAM does do is receive raw zircon sand and through mechanical, electrical and chemical processes enhances the materials usefulness for its industrial clients located throughout the US and around the world.

TAM continues to maintain their radioactive materials license on a very rudimentary level to support the potential for the HPZ project to move ahead given that future supplies of zircon sand less than 500 ppm uranium plus thorium are not readily predictable. It is always possible that some time in the future raw zircon sand containing less than 0.05 weight percent U + Th may be in scarce supply. Therefore, maintaining the radioactive materials license will allow TAM to act quickly and precisely to affect a license amendment and gear up the existing radiation protection program should such a situation arise.

Given the work performed to support and maintain the radioactive materials license and the research into zircon use throughout the ceramics industry, TAM is acutely aware of the radiological and the industrial hygiene status of the site. To further this knowledge of their own site, TAM's radiological consultant, the MJW Corporation Inc. performed additional radiological monitoring and characterizations of the site in May and June 1993. This report entitled "Radiological Survey and Analysis of Random and Biased Air Samples Collected at TAM Ceramics, Inc." measured direct radiation levels, contamination levels and airborne levels in selected areas throughout the plant.

In summary, this report shows that direct radiation measurements vary from a background level of 10 μRem/hr to as high as 80 μRem/hr at one meter from raw material and/or finished product. The highest contact measurement was 180 μRem/hr. Contamination levels ranged from 0 to 58 dpm/100cm^2 with an average of 26 dpm/100cm^2. These average levels are nearly a factor of 10 below the 12 NYCRR 38 Table 5 acceptable surface contamination levels for the most restrictive level for the nuclide present at TAM (200 dpm/100cm^2 for natural thorium). Airborne radioactivity measurements were made throughout the plant in areas of high dust loadings (biased samples) and at several other locations throughout the plant (random samples) in both May and June of 1993. The results were averaged for each of the seven measurement locations. The percent Annual Limit on Intake (ALI) for normal operations ranged from 1.12 to 29% with an average of 7.5% ALI. The dust loading throughout all plant facilities ranged from 1.08 to 1.96 mg/M^3 with an average of 1.51 ± 0.34 mg/M^3. Levels of dust in zircon and zirconia processing facilities which are considered as an action level concentration based on the uranium and thorium content of the ore in recently published papers are on the order of 2.76 mg/M^3 (see Leigh, 1979 and Lischinsky et.al., 1991). Nuisance dust level limits under OSHA are on the order of 5 mg/M^3 (Dupont Zircon Seminar, 1992).

In summary, as a result of applying for and maintaining a radioactive materials license since 1991, the radiological environment of the entire TAM facility has been well characterized. The license has been inspected annually since 1992 with no violations or citations. Finally, all direct airborne dust and contamination level measurements made

over the past 7 years have demonstrated that even under worst case considerations a radiological monitoring program for TAM personnel is not required based on the fact that the maximum potential dose received by TAM workers is less than 10% of any applicable occupational radiation dose limit. Since the site is a secure industrial facility, no one other than TAM employees and their invitees will have access to the undeveloped area of the site.

2.6 The Undeveloped Property

2.6.1 Historical Perspective at the Time of Sale

In 1978, NL Industries responded to a questionnaire circulated by the New York State Interagency Task Force on Hazardous Wastes (Task Force). The Task Force was formed to identify manufacturing and waste disposal practices of manufacturing facilities in New York State. The questionnaire was designed to obtain information from New York State manufacturing facilities regarding company history and personnel, products, waste production, and disposal methods (both on-site and off-site). Based on the recollection of employees at that time and other available data, NL Industries identified on-site disposal methods for a number of off-specification products and by-products.

Later in 1978, in response to a Task Force request for additional information about waste disposal practices at the facility, NL Industries provided the Task Force with a map that identified disposal sites used by NL Industries at the facility. A representation of the map is presented in Figure 2-3 of BB&L, 1995. In addition, NL Industries responded with a letter, which stated that the on-site landfill material at NL's Hyde Park location was secured with a soil cap. In the follow-up letter, NL also identified additional wastes shown on the map. After purchasing the facility in 1978, TAM removed the aboveground wastes from the Site.

2.6.2 Site Classification by NYSDEC and NYSDOL

In December of 1983, the NYSDEC and the New York State Department of Health (NYSDOH) listed the Site as a Class 2a Site on the New York State Registry of Inactive Hazardous Waste Sites.

In 1986, a Phase I Investigation was performed by Engineering-Science and Dames & Moore for the NYSDEC to assess the hazards to the environment caused by the Site. The investigation utilized existing documents and included a site visit. The findings of the site investigation were based on the Hazard Ranking System (HRS), which involves the compilation and rating of various geological,

toxicological, environmental, chemical, and demographic factors, and the calculation of an HRS score. The Phase I report recommended that a Phase II Investigation, consisting of a geophysics survey and sediment and groundwater analysis for Hazard Substance List (HSL) metals, be performed at the Site.

2.6.3 Remedial Work Performed to Date by TAM/TAM Contractors

In July of 1990, the contractor for the Occidental Chemical Hyde Park Landfill Remediation Project (Sevenson Environmental) discovered a number of buried drums while excavating to relocate a portion of railroad track located on TAM property. The location of these drums is shown on Figure 2-3 of BB&L, 1995. The drum contents were sampled and analyzed, and found to contain zirconium oxide. A total of 178 drums were removed from the excavation. TCLP analysis of the drum contents indicated that all concentrations were below USEPA maximum concentration of contaminants for toxicity characteristics. Therefore, the drums were classified as non-hazardous, and disposed of at Modern Disposal's Landfill in Model City, New York, in August, 1991. The environmental media (soil) moved to reach the drums (approximately 1,000 cubic yards) was placed in a clay-lined bermed area on TAM's property. The analytical results for samples of this soil indicated levels of constituents below USEPA maximum concentrations of contaminants for the toxicity characteristics, and did not indicate the presence of any of the constituents found in the drums. This indicates that there had been no contact between the soils and the waste in the drums.

In March of 1991, TAM Ceramics received notice from NYSDEC that Ecology and Environment, P.C. (E & E) would be performing a PSA at the facility. The "PSA approach" had recently been developed by the NYSDEC as a "hydrid" of the Phase I and Phase II Investigations. Site visits by E & E and NYSDEC in April and May of 1991 identified two areas of concern in the eastern portion of the undeveloped area. The two areas were sampled and analyzed for full TCLP parameters. The analytical results indicated that concentrations of constituents were below USEPA maximum concentrations of contaminants for the toxicity characteristics, with the exception of some white material, which showed a TCLP concentration of 190 mg/l for barium, which exceeds the USEPA regulatory limit of 100 mg/l.

Early in 1992, TAM Ceramics retained Empire Soils Investigations (ESI) to perform a test pit excavation program, to estimate the quantities of waste in the eastern portion of the site, specifically the areas that were identified in the May 1991 site walkover for the PSA by E & E and the NYSDEC. In May 1992, ESI performed the test pit program with NYSDEC oversight. A total of 18 test pits were excavated. Three areas of potential waste disposal were identified as Areas

A (Blue Material), B (Gold Material, Black Liquid/Water), and C (White Material). ESI estimated the extent of each waste type within the areas as follows:

- Area A 2,433 cubic feet
- Area B 1,450 cubic feet
- Area C 8 cubic feet

Four waste samples from these three areas were split between the NYSDEC and TAM Ceramics, Inc. The analytical results for these samples confirmed the original analyses, with Area C material exceeding the USEPA limit of 100 mg/l for barium. This sample was tested using the EP Tox method which indicated a result of 5,130 mg/l. Based on these results, this waste was removed as an Interim Remedial Measure(IRM) in accordance with the Removal of Barium Waste Work Plan (BB&L, April 1993). The final report for this project was approved by the NYSDEC in August 1994.

2.6.4 NYSDEC Oversight of Remedial Projects

In November 1992, TAM received correspondence from the NYSDEC stating that the NYSDEC had selected a contractor to perform a Remedial Investigation/ Feasibility Study (RI/FS) at the site. However, the NYSDEC placed its contractor on hold in order to provide TAM Ceramics the opportunity to perform their own characterization program, which TAM Ceramics agreed to perform.

On December 16, 1992, representatives of TAM Ceramics, NL Industries, the NYSDEC, and BB&L met at the Region 9 NYSDEC offices in Buffalo, New York, to define the general scope and procedures to be utilized in the Site Characterization Program. As a result, BB&L prepared a Site Characterization Work Plan (BB&L, July 1993) detailing the procedures and methods to be used during implementation of the Site Characterization Program.

TAM and the NYSDEC negotiated an Administrative Order on Consent, Index Number B9-0430-93-04, which included the "Removal of Barium Waste Work Plan" (BB&L, April, 1993) and the "Site Characterization Program Work Plan" (BB&L, July, 1993). The details associated with the implementation of these work plans are presented in the NYSDEC-approved "Removal of Barium Waste Final Report" (BB&L, June, 1994) and the "Site Characterization Program Final Report" (BB&L, March, 1995), respectively.

2.6.5 Description of Areas of Radiological Concern

The radiological survey of the NL Industries site as described by Leigh (1979) collected air, groundwater and soil samples on the undeveloped property. The method for choosing the locations coincided with known historical waste disposal areas on the property. Laboratory analysis of the 14 samples collected from the eight excavations showed naturally-occurring uranium and thorium concentrations to be at or near background levels. Further, direct radiation surveys of the interiors of the excavations showed gamma radiation levels to be consistent with background levels.

No other radiological surveys of the undeveloped property were performed between 1979 and 1993. With the approval of the Site Characterization Work Plan (BB&L, July 1993) the stage was set to perform additional site characterization work which included radiological analysis of samples and direct radiation readings of all intrusive activities conducted at the site. Direct radiation readings were observed at approximately 5 times area background levels in TP-12 (BB&L, 1995). The material was sampled and analyzed for uranium and thorium content. Total thorium was in the range of background (i.e. 1-3 pCi/g) while total uranium was measured at 100-120 pCi/g, typical for zirconia. Sample TP13-2 collected about 150 feet north of TP-12 showed a zirconium concentration of 28.8 weight percent (w/o).

In August of 1995, NYSDEC representatives collected additional samples from TP-12 and the surrounding areas. Sample analysis showed that the material contained above background concentrations of uranium, thorium and radium-226. During the site investigation by NYSDEC the source of the radioactivity was found to be a light grey material. A total of six (6) areas were found to be above background direct radiation levels, with all the above background readings being attributed to the presence of the light grey material on or near the surface. Direct radiation readings at one meter were on the order of 200 to 250 μR/hr and contact readings were about 400 μR/hr. Additional details of this investigation are found in (NYSDEC, 1995).

2.6.6 NYSDEC Field Investigation Conclusions

The NYSDEC field investigation concluded that sample results "differed greatly" from the BB&L results for TP-12. The most probable reason for the difference in results is a significant difference in sampling methodology and equipment. BB&L collected samples from a large area under a protocol appropriate to the Site Characterization Program. The DEC sampling was specifically targeted at individual deposits of homogeneous material. BB&L only reported uranium and thorium results. The BB&L sampling and report protocol was, however, agreed upon with the DEC and was appropriate in light of the history of site operations -

that is, the use of minerals with between 0.03 and 0.05 percent by weight of naturally occurring uranium and thorium in secular equilibrium. For purposes of the Site Characterization Program, there was no rationale for performing a more complete radiological analysis of individual samples. The BB&L data was based upon alpha spectroscopy or GeLi gamma spectroscopy of targeted samples. Therefore, the difference in results is most likely due to the heterogeneity of the BB&L sample compared to the homogeneity of the NYSDEC sample. The differences are not due to the effect of U-235 analysis masking radium-226 analysis due to similar energy photopeaks, since the U-235 concentration for the TP12-1 sample was based on the U-235 143.8 keV gamma peak and not the 185.7 keV peak. Moreover, the U-235 concentration range reported by BB&L agrees well with the predicted activity range of 2.14 to 2.57 pCi/g based on secular equilibrium conditions for these naturally occurring materials. If the U-235 contribution at 185.7 keV is accounted for as contributing to the Ra-226 peak at 186.2 keV, then the Ra-226 concentration measured by the analytical lab for sample TP12-1 was 207 pCi/g which agrees with the NYSDEC analysis for Ra-226 which averaged ~152 pCi/g for 5 samples. MDAs for these gamma spectroscopy analyses for U-235 and Ra-226 in the BB&L TP12-1 sample were 4.4 pCi/g and 15.3 pCi/g, respectively.

The Department has expressed a concern, based on its initial field investigation, that the site may contain radium contamination in addition to naturally occurring uranium and thorium. In view of the operational history of the site and the materials which have been used there for the past fifty years, the most probable explanation for the presence of radium would be the presence of these mineral-based natural materials.

NCRP report number 118 (1993) entitled "Radiation Protection and the Mineral Extraction Industry" in Table 3.1 lists the naturally occurring radioactivity related to mineral resources. Zirconium, for example, is listed as having 108 pCi/g of uranium, 16 pCi/g of thorium and between 108 and 190 pCi/g of radium. The average values for the five samples analyzed by the New York State Department of Health Laboratory for uranium, thorium and radium were 60 pCi/g uranium, 12.7 pCi/g for thorium and 151.6 pCi/g for radium - well within the expected concentration range listed above for zirconium. National Lead was known to have processed zircon and zirconia for over thirty years. The results obtained by the New York State Department of Health are entirely consistent with the known properties of these naturally-occurring materials.

These product materials are now and have always been unregulated and are not subject to licensing of any kind. It is TAM's belief that the activity levels detected both by BB&L and by the Department are fully accounted for by the presence of mineral product materials placed on or into the undeveloped property. It is also TAM's belief that these materials are well below the source material

limit of 500 ppm and therefore would continue to be unregulated material. TAM understands, however, the Department's concern with respect to this matter and is willing to conduct additional testing to satisfy the Department that the materials present at the site are, in fact, unregulated naturally occurring radioactive materials.

TAM however does not believe that a large scale survey of the entire undeveloped area is necessary for this purpose. The entire undeveloped area has already been subjected to a site-wide geophysical survey and any significant deposits of non-native materials have been identified. Thus, the area of radiological concern is now relatively well defined. It consists of an area of the undeveloped property in the vicinity of TP-12. This area is unoccupied, fenced and not accessible to the general public. The materials present there have been analyzed from a chemical point of view and it is known that they are inert and not soluble in water. The principal focus of the additional investigation, therefore, should only be based upon a more complete radiological characterization of this material and the general area it presently occupies.

3.0 Proposal for Additional Site Radiological Characterization

3.1 General

In light of the differences between the sampling rationale and methodology used in the Site Characterization Program Final Report (BB&L, 1995) and the sampling rationale and methodology used by NYSDEC, TAM Ceramics, Inc. suggests that additional samples be collected from the area surrounding TP-12 and be analyzed to determine more precisely the nature of the materials present and their radiological characteristics. To date, no systematic overland gamma survey of this portion of the undeveloped property has been performed. The surveys conducted to date have consisted of random direct radiation measurements taken along the fence line by National Lead in 1979, measurements of test pit excavations and nearby areas conducted by several contractors and the ad hoc measurements taken by NYSDEC officials in its most recent examination of this area.

In order to ultimately set to rest the Department's concerns with respect to the radiological characteristics of the site, TAM believes that a gamma survey of this area of concern should be performed. Such a survey should provide data which will definitely characterize the nature of the materials present at the site, their radiological status and their physical distribution.

3.2 Regulatory Concerns

Another goal of the systematic overland gamma survey of the area surrounding TP-12 should be to determine whether and to what extent the materials present there are subject

to regulation. Part 380 of the New York Code of Rules and Regulations applies to radioactive materials whose receipt, possession, use, transfer, and disposal are subject to general or specific licensing and regulatory control. The naturally occurring radioactive materials which are used by TAM Ceramics, Inc. have already been the subject of intense regulatory scrutiny by the New York State Department of Labor and are known to be exempt from regulation because they do not exceed a concentration of 500 ppm combined uranium plus thorium (or 0.05 percent by weight U + Th). The focus of the radiological survey to be conducted pursuant to this work plan should, therefore, be to determine whether the materials present in the area of concern are in fact products or other mineral materials which are exempt from regulation. If it can be proven that these materials are, in fact, exempt from regulation, the Department's concern should be resolved. If the materials are subject to regulation, further questions concerning their fate would need to be addressed at that time.

It is also important to note that the material present at the TAM site has been examined and is known to be inert and insoluble. The radiological survey contemplated by this work plan should confirm as well that there is no risk of any waterborne "effluent" from the materials present at the site in violation of any applicable regulatory standard.

Finally, if any materials which are subject to regulation are present at the site, the data collected pursuant to this work plan should be analyzed to determine whether and to what extent the presence of this material would cause any person reasonably expected to be at this secure industrial site to receive a radiation dose in excess of any applicable regulatory limit.

3.3 Focus Area

The ad hoc overland gamma survey performed by NYSDEC personnel in August of 1995 identified six areas where direct radiation readings at the surface were above background levels. These areas were located in the western most area of the property in the vicinity of TP-12 and just north of TP-12 slightly east of monitoring wells NPW-H2U, -H2M and -H2L. These areas identified by the State agree very well with the location of areas shown on Figure 2-3 (BB&L, 1995). It is assumed, although not specifically stated, that the ad hoc NYSDEC direct radiation survey extended approximately 50 feet east from the property fence and 150 feet north and south along the fence in the area of TP-12. All of the above-mentioned areas are presented in the TAM Ceramics Site Diagram in the NYSDEC 1995 reference. The total estimated foot print of this area is approximately 1,600 square feet. No other location in the undeveloped area investigated pursuant to the Site Characterization Program was identified as having or contained any significant quantity of materials which are likely to possess levels of naturally occurring uranium and thorium above background concentrations. Therefore, the focus of the investigation should be upon the area surrounding TP-12. It is suggested that an area 150 feet wide by

400 feet long with TP-12 near the center of the area by initially examined. This initial area of investigation can then be expanded, if necessary, to fully encompass the physical distribution of any actual contamination.

3.4 Characterization Methodology

3.4.1 General

There are two key issues which must be addressed to satisfy the Department's concerns with respect to characterizing the materials present in the focus area. The first issue is the geographic distribution of the material and the second is the radiological activity of the material. The NYSDEC and BB&L samples from the TP-12 area do not match up radiologically because it appears that the BB&L sample (BB&L, 1995) contained soil and/or other constituents which had no radioactive component and therefore may have diluted the sample results with respect to the measured uranium and thorium content. To resolve this issue, an overland gamma survey of the area around TP-12 is in order.

3.4.2 Overland Gamma Survey

A 20 foot by 20 foot grid has already been laid out across the site to support previous investigative work (BB&L, 1995). This grid is about 1/3 smaller than that which would be necessary to support a systematic overland gamma survey which is typically layed out on a 10 meter by 10 meter grid when radioactivity is known to exist at a site. Therefore, the existing 20 foot by 20 foot grid will ensure that the site is more than adequately surveyed. In any areas which are measured at more than twice normal background levels, 3 foot by 3 foot grids would be established to better define the area radiation levels.

During the performance of the initial 20 foot by 20 foot grid surveys, intragrid surveys will be performed by starting in one corner of the grid, and using a zigzag pattern, the entire grid will be surveyed in approximately 3 foot intervals. Direct radiation measurements at 1 meter and 1 centimeter above the ground surface will be recorded at each grid point location using a 2 inch by 2 inch NaI detector coupled to an ESP-1 ratemeter/scaler. In areas where readings exceed twice background, direct radiation readings will also be taken using a Bicron microRem LE low energy tissue-equivalent dose rate meter. These dose rate data can then be used to support dose analysis which may be required to meet applicable regulatory requirements, if any.

3.4.3 Sample Collection and Analysis

Sample collection will be performed in accordance with approved EPA methodology. Samples will be analyzed for their radiological content as well as for their chemical make-up. This additional characterization data should allow for a better understanding of the nature of this material.

The inorganic analysis will focus on the presence of titanium, silica and zirconium; the three major elements which would normally be associated with naturally occurring uranium and thorium within the raw ore crystalline matrix.

The radiological analysis will test for the presence of uranium and thorium and for daughter products of the two decay chains. A standard gamma isotopic will also be run on all samples to determine if any other nuclides are present in any significant quantity.

Additional soil samples may be collected based on the results of the initial overland gamma survey of the property. The grid will be expanded, as necessary, until the areal extent of contamination is defined. At least one background soil sample collected at an off-property location with similar geological characteristics will be analyzed to confirm the native concentrations of uranium and thorium.

3.5 Data Interpretation and Reports

The results of the overland gamma survey will be plotted using state-of-the-art color graphics to depict any elevated gamma readings measured. All results will be reported either as net counts per minute (CPM) for the NaI detector surveys or as μR/hr for the tissue-equivalent detector surveys of areas above ambient background levels. Soil sample locations will be mapped in relation to the 20 foot by 20 foot grid previously established by surveyors across the site. Results of samples will be reported and discussed in relation to previous manufacturing operations.

4.0 Summary

In summary, this work plan has attempted to address concerns raised by NYSDEC with regard to the radiological status of the undeveloped property. Since purchasing the property from NL in 1979, TAM has disposed of nothing on the undeveloped property. Further, TAM's business has not in the past nor does it currently use licensable quantities of radioactive material. What TAM does use is essentially beach sand containing zirconium and other similarly benign mineral materials. The exempt material which TAM uses is sold to the customer (end user) as exempt material. It can be sold and purchased by the ton as exempt material.

The overland gamma survey and additional soil sample collection and analysis based on the results of the overland gamma survey should allow TAM to address the concerns raised in the Department's 1995 report (NYSDEC, 1995).

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