APPROACH TO DEVELOP CLEAN-UP LEVELS FOR CONTAMINANTS OF CONCERN IN SOILS AT THE SOLAR EVAPORATION PONDS

1.0 INTRODUCTION

The July 1, 1988 closure plan assumes closure of the ponds as a landfill utilizing a cap to cover contaminated soil areas. The extent of the cap was determined by the completed site characterization study presented in Appendix 6 of the closure plan. Closing the solar ponds as a landfill with contaminated soil results in a unit which will require long-term institutional controls at the source area. These controls would be required after the groundwater corrective action is complete. A remedial soil action for the solar pond source area soils, such as removal, would allow closure of the source without a cap, and would eliminate the long-term controls. However, pursuant to RCRA closure regulations for surface impoundments [40 CFR 264.228(a)(1)], all contaminated soils would have to be removed. This may prove to be impractical at the solar ponds.

In order to make the closure consistent with remediation of CERCLA sites at the Rocky Flats Plant, it is proposed that the closure performance standards for the soil remedial action be established by a risk assessment process, which is discussed herein. The risk assessment would be conducted to establish allowable soil concentrations that are protective of both human health and the environment through all plausible routes of human exposure except through the ground-water pathway. This pathway is not considered because ground-water corrective action will be implemented to achieve compliance with the ground-water protection standard at the compliance point. Soil remedial actions for closure of the solar pond source areas would be targeted at achieving these risk based closure performance standards. This approach is also consistent with he closure performance standard at 40 CFR 264.111(b) which states closure must minimize or eliminate, to the extent necessary to protect human health and the environment, post closure escape of hazardous constituents.

The establishment of target levels on the basis of risk to human health and the environment depends on a range of factors including the nature of the contaminants of concern, the characteristics of the receptor populations potentially exposed, the

routes of exposure that may be involved, and the location of potential receptors relative to the site.

The approach proposed to establish clean-up levels attempts to provide an organized and technically defensible process for establishing clean-up levels in soil which will ensure that potential receptors (both human and non-human) are afforded an acceptable level of protection.

The Solar Pond Closure Plan, dated July 1, 1988, could be modified to include the risk assessment process with the existing capping alternative reserved as the contingency plan for closure in the event that further evaluations indicate closure without a cap is not possible.

Additional soil characterization will be required to complete the risk assessment and estimate the volume of soil to be remediated. If soil removal is selected as the remedial alternative, the soil will be treated and/or disposed at an approved off-site facility. Ground-water contamination will continue to be addressed by implementing a monitoring and remediation program.

2.0 TECHNICAL APPROACH

The determination of clean-up levels for each of the contaminants of concern will consist of the following steps:

- Review of existing data to determine if soil contamination is thoroughly characterized and that data are validated environmental measurements.
- Determination of future use scenarios and identification of pathways of concern.
- Prediction of contaminant transport from Solar Ponds (source term) to potential points of receptor exposure.
- Development of media-specific acceptable daily intakes based on the intrinsic toxicity (carcinogenic and non-carcinogenic) of each of the contaminants of concern.
- Determination of allowable soil concentrations for each of the contaminants of concern.

The technical approach outlined herein is based on the following principal assumptions:

1. Reliance exclusively on data generated during investigations of the solar ponds.

2. The development of future land and water use scenarios that are plausible and that are agreed upon, prior to the conduct of this assessment by Rockwell, U.S. DOE, U.S. EPA, and the Colorado Department of Health.

3. Contaminant transport through various environmental media occurs under equilibrium conditions.

4. Target levels may not necessarily represent the final "action" objective. Additional criteria which may influence the ultimate remedial design include institutional issues (applicable federal or state standards) and/or restrictive use criteria in cases where suitable technologies are not available.

2.1 REVIEW OF EXISTING DATA

Available sampling data will be reviewed to determine whether additional data need to be collected to thoroughly characterize the concentrations and physical distribution of contaminants. General recommendations will be made for the collection of additional samples, if warranted. The following technical elements will be performed:

- Review all available sampling data and associated quality assurance/quality control information for the site.

- Determine data adequacy with regard to locations sampled, number of samples taken, and parameters analyzed.

- Propose recommendations for additional sampling and analysis, if warranted.

- Determine which chemical constituents are contaminants, i.e. compare site concentrations to background concentration ranges.

- Summarize contaminant concentration levels found in environmental media at and near the site.

2.2 IDENTIFICATION OF "CONTAMINANTS OF CONCERN"

"Contaminants of Concern", also known as "indicator chemicals", represent the site-related contaminants that pose the greatest hazard to human health or to the environment. They will be selected according to their (1) intrinsic toxicity, (2) magnitude (concentration and/or quantity) of contamination, (3) mobility in the environment, and (4) environmental persistence. The following technical elements will be performed:

- For nonradioactive contaminants, the contaminants of concern will be selected using guidelines described in the Superfund Public Health Evaluation manual (U.S. EPA, 1985). These steps include, but are not limited to, the following activities:

  1) Calculation of indicator scores (based on concentration and toxicity) for nonradioactive chemicals.

  2) Initial selection of nonradioactive indicator chemicals based on indicator scores.

  3) Final selection of indicator chemicals based on consideration of other factors, including relevant chemical properties (e.g., vapor pressure, persistence, etc.).

- All radioactive substances measured at levels above natural background will be considered contaminants of concern.

2.3 DEVELOPMENT OF EXPOSURE SCENARIOS

Total contaminant intake is a function of the different routes by which the human/ecological population may be exposed. Consequently, to establish clean-up levels for the soil it is necessary to establish future use scenarios for the solar ponds site and its surroundings following facility abandonment. Several potential land uses following site remediation and facility abandonment may occur and include:

- Residential
- Open Space
- Commercial
- Industrial

Because it is currently uncertain as to what use(s) may eventually be decided for the site, it is proposed that soil clean-up objectives be derived for that use which may potentially result in the greatest degree of exposure, i.e. residential development of the site. Under this scenario, the following pathways of exposure would need to be assessed for the solar ponds remediation:

- o Dust inhalation
- o Soil ingestion (adult)
- o Pica (child)
- o Vegetable consumption (home garden)
- o Vapor inhalation from soils
- o Dermal contact

Note that Rockwell recommends a meeting be held with the U.S. EPA, CDH, and U.S. DOE to determine criteria for establishing future use scenarios for this site. The need to establish clean-up levels based on "plausible" risk warrants serious considerations not only for solar pond remediation but also for other site remediations.

2.4 QUANTIFICATION OF CONTAMINANT TRANSPORT

After the potential exposure pathways have been determined, exposure point concentrations for each of the contaminants resulting from contaminant migration through each of the appropriate media will be assessed. Contaminant transport will be assessed to determine an exposure factor for a given pathway. The exposure factor represents the degree to which the contaminant concentration will be reduced in moving from the source to the point of exposure through a specific medium (e.g. air, food). The derivation of the exposure factors will require the prediction of the environmental fate and transport of each contaminant in the identified medium of the exposure pathway.

2.5 TOXICITY ASSESSMENT

For each of the contaminants of concern, an acceptable daily intake will be derived for both oral and inhalation exposure if applicable. The ADI, also known as

the risk reference dose (RfD), will be used to define the dose protective of non-carcinogenic effects. Doses equivalent to the one-in-one-million risk level will serve as the basis for carcinogenic risk. For both carcinogenic and non-carcinogenic toxicity, Rockwell will utilize the U.S. EPA's Integrated Risk Information System (IRIS). IRIS represents EPA's central database for periodically updating human health assessments and other toxicological information. For ecological toxicity, Rockwell will utilize a number of ecotoxocity databases. Where possible, toxicity data will rely most heavily on studies using standard evaluation procedures developed by the EPA's Ecological Effects Branch.

2.6 DERIVATION OF "ACTION" OR "TARGET" SOIL LEVELS

The basic approach to establishing target clean-up levels is to relate the human or environmental receptor dose to the soil concentrations at the source. In this case an acceptable dose is determined during the toxicity assessment conducted previously. The acceptable dose is converted to a media-specific concentration using the appropriate intake algorithm.

Because exposure to contaminants may occur through a number of pathways, a cumulative level for each of the contaminants of concern through the appropriate combination of pathways will be derived as follows:

$$\text{Cumulative Target Clean-up Level} = 1 \Big/ \left(\frac{1}{TCL_{(dust)}} + \frac{1}{TCL_{(veg)}} + \cdots \frac{1}{TCL_{(pathway)}} \right)$$

Where TCL = the pathway-specific target clean-up level

In addition to the Cumulative Target Level for the additivity of exposure routes, the cumulative effect of contaminant mixtures will also need to be evaluated. It should be noted, however, that there generally exists a single, or a very few, contaminant(s) which, due to their intrinsic toxicity, drive the risk level and the consequent remediation. This approach concedes that the remediation of that pollutant (or selected few pollutants) will, in almost all cases, protect human and/or environmental health against the additive, synergistic, or antagonistic effects of the contaminants of concern.