U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

PRESENTATION TO THE NUCLEAR WASTE TECHNICAL REVIEW BOARD

SUBJECT: RADIOLOGICAL STUDIES

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OBJECTIVES OF THE RADIOLOGICAL STUDIES PROGRAM

- MONITOR THE EFFECTS OF SITE CHARACTERIZATION ACTIVITIES
- ASSURE COMPLIANCE WITH APPLICABLE RADIOLOGICAL REGULATIONS
- COLLECT THE RADIOLOGICAL DATA NEEDED TO SUPPORT DESIGN OF FACILITIES
- COLLECT RADIOLOGICAL DATA NEEDED FOR EMERGENCY PLANNING AND POST-CLOSURE MONITORING

OBJECTIVES OF THE RADIOLOGICAL STUDIES PROGRAM

(CONTINUED)

- COLLECT DATA TO CHARACTERIZE THE IMPACTS OF RADIOLOGICAL FACILITIES SURROUNDING YUCCA MOUNTAIN
- COLLECT DATA AND IMPLEMENT PROGRAMS TO ASSURE THE RADIOLOGICAL PROTECTION OF THE PUBLIC, WORKERS, AND THE ENVIRONMENT
- QUALIFY DATA COLLECTED IN THE PAST AT NTS (TO THE EXTENT PRACTICABLE)
- IMPLEMENT A TOTAL QUALITY ASSURANCE PROGRAM TO ASSURE THE VIABILITY OF THE DATA COLLECTED

TECHNICAL APPROACH

- IDENTIFY AFFECTED AREA AND RADIONUCLIDES OF IMPORTANCE
- EVALUATE PATHWAYS
- MONITOR IMPACTS
- USE A TEAM MADE UP OF SAIC, EPA, AND EG&G TO IMPLEMENT THIS ACTIVITY
- REQUESTED STATE OF NEVADA FULL PARTICIPATION IN PROGRAM

TECHNICAL QUESTIONS

1. WHAT AREA SHOULD BE MONITORED AND FOR HOW LONG?

2. WHAT ARE THE RADIONUCLIDES OF INTEREST?

3. BASED ON POTENTIAL PATHWAYS TO THE PUBLIC AND WORKER SAFETY IMPACTS, WHAT MEDIA SHOULD BE MONITORED?

4. WHAT EQUIPMENT SHOULD BE USED AND WHERE SHOULD IT BE LOCATED?

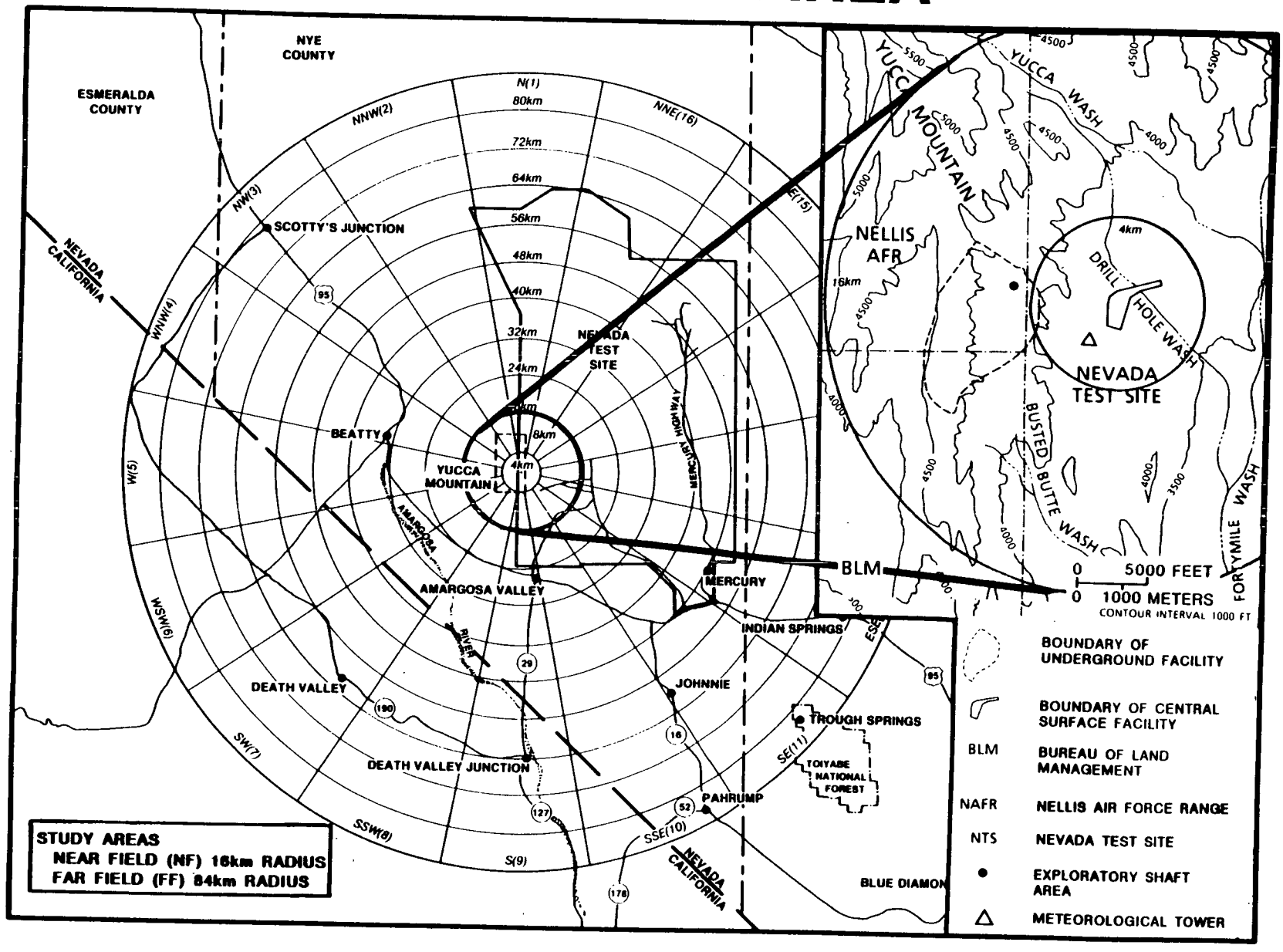
5. WHAT ARE POTENTIAL IMPACTS OF SITE CHARACTERIZATION ACTIVITIES ON THE PUBLIC?

TECHNICAL QUESTION 1: WHAT AREA SHOULD BE MONITORED AND FOR HOW LONG?

TECHNICAL APPROACH

- USE A GEOGRAPHIC AREA BASED ON DOE GUIDANCE AND NRC REGULATORY GUIDES
  - 80 KILOMETER CIRCLE
  - LAS VEGAS AS THE NEAREST URBAN AREA (10 CFR 960)
- MONITOR FOR A PERIOD ADEQUATE TO CHARACTERIZE THE CURRENT RADIOLOGICAL BACKGROUND PRIOR TO PREPARATION OF DEIS, SAR, AND FINAL DESIGN
  - FIVE YEARS OF DATA PLANNED FOR SITE WITH A TIME - DEPENDENT BACKGROUND (BASED ON CONSIDERATION OF THE VARIABILITY IN THE DATA AND THE LEVEL OF ACCURACY REQUIRED)

RMP STUDY AREA



TECHNICAL QUESTION 2: WHAT ARE THE RADIONUCLIDES OF INTEREST?

TECHNICAL APPROACH

- THE RADIONUCLIDES OF INTEREST ARE BASED ON:
  - 40CFR191 (TABLE 2)
  - RADIONUCLIDES PRESENT FROM PAST NTS ACTIVITIES
  - RADIONUCLIDES FROM PROJECTED NTS ACTIVITIES
  - RADIONUCLIDES PRESENT IN PROJECTED WASTE MATERIAL
  - NATURALLY OCCURRING RADIONUCLIDES WHICH MAY HAVE AN IMPACT
  - CONSIDERATION OF POTENTIAL PATHWAYS

RADIONUCLIDES OF INTEREST

Table 4-3. Radionuclides of interest (page 1 of 4)

Radionuclides	Source: Spent Fuel[b] NTS[a]	Spent Fuel[b] > 0.01% 10 years	Spent Fuel[b] > 1% 10,000 years	Spent Fuel[b] HLW	Naturally[c] occurring	40 CFR 191 Table 2	Emissions[d]	Reference (See page 4 of table)
H-3	x						b (0.0186)	5, 6
Be-7					x		U	
C-14					x	x	b (.156)	4
K-40					x		b, U	
Fe-55		x					UC, x-rays	1
Co-60		x		x			b, U	2
Ni-59			x				EC, x-rays	1
Ni-63		x		x			b (0.067)	1, 2
Kr-85	x	x					b, U	1, 5, 6
Sr-89	0							5,6
Sr-90/Y-90	x	x		x		x	b	1, 2, 4, 6
Zr-93/Nb-93m				x			b (.06) x-rays	2
Tc-99			x	x		x	b (.292)	1, 2, 4
Ru-106/Rh-106		x					b, U	1
Sn-126/Sb-126m/ Sb-126						x	U, b	2, 4
Sb-125/Te-125m		x					b, U	1
I-129						x	b (.15) U (.04) x-rays	4
I-131	0						b, U	6
I-133	0						b, U	6
I-135	0						b, U	6
Xe-133	0						b, U	5, 6
Xe-133m	0						U	6
Xe-135	0						b, U	6

Table 4-3. Radionuclides of interest (page 2 of 4)

Radionuclides	Source: Spent Fuel[b] NTS[a]	Spent Fuel[b] > 0.01% 10 years	Spent Fuel[b] > 1% 10,000 years	Spent Fuel[b] HLW	Naturally[c] occurring	40 CFR 191 Table 2	Emissions[d]	Reference (See page 4 of table)
Cs-134		x		x			b, U	2
Cs-135						x	b (.21)	4
Cs-137/Ba-137m	x	x		x		x	b, U	1, 2, 4, 6
Ce-144/Pr-144		x					b, U	1
Pm-147		x					b (.224)	1
Sm-151		x		x			b (.076) U (.022)	1, 2
Eu-154		x					b, U	1
Eu-155		x					b, U	1
Rn-220/D					x		O, b, U	3
Rn-222/D					x		O, b, U	3
Ra-226			x		x	x	O	1, 4
Th-230					x	x	O, U	4
Th-232					x	x	O	4
U-233					x	x	O	4
U-234			x		x	x	O	1, 4
U-235					x	x	O	4
U-236						x	O	4
U-238[e]	x	x	x		x	x	O	4
Np-237						x	O	1, 4
Np-239			x				b, U	1
Pu-238	x	x		x		x	O	1, 2, 4
Pu-239	x	x	x			x	O	1, 4, 6
Pu-240	x	x	x			x	O	1, 4
Pu-241	x	x		x			b, x-rays	1, 2
Pu-242						x	O	1, 4
Am-241	x	x				x	O	1, 4
Am-243			x				O	1, 4
Cm-243		x					O	1
Cm-244		x					O	1

Table 4-3. Radionuclides of interest (page 3 of 4)

Radionuclides	Source: NTS[a]	Spent Fuel[b]: > 0.01% 10 years	Spent Fuel[b]: > 1% 10,000 years	Source: HLW	Source: Naturally[c] occurring	Source: 40 CFR 191 Table 2	Source: Emissions[d]	Reference (See page 4 of table)

Footnotes

[a]The "0" indicates these radionuclides are not asssociated with projected NNWSI activities but may be associated with Nevada Test Site (NTS) activities and could interfere with projected monitoring activities. Radionuclides not identified with a "0" also occur in potential waste forms for disposal at a repository. This is based on data reported in the annual environmental reports. It is projected that slight concentrations of all isotopes listed may be present.

[b]Percent of total activity per fuel element.

[c]These are naturally occurring radionuclides which must be addressed per 30 CFR 57. Note other naturally occurring radionuclides (K-40 and Be-7) will be included in the analysis to allow evaluation of the analytical techniques.

[d]O = Alpha radiation, b = Beta radiation, and U = gamma radiation. The energy values in MeV are provided for low energy b radiation as an indication of the difficulty in measurement. Also U and x-ray emitting radionuclides, except the energy (in MeV) indicated, will be detected using gamma spectral measurements.

[e]U-238 is not included in the actual percent of activity assessment due to its low specific activity. However, it is a very significant mass fraction, so it is included.

Table 4-3. Radionuclides of interest (page 4 of 4)

Reference Number Indicated Above	Source
1	ORNL/TM-9591/V1&2, Tables 3-5, 3-6, 3-7, 3-8, 3-9, 3-10. NOTE: >0.01% for 10 year old fuel. All listed isotopes to 10,000 year old fuel.
2	DP-1606, Rev. 1 (August 1983). Table 5 and Table 11. NOTE: >0.01%
3	NCRP Report 50, Section 2.3.5.
4	40 CFR Part 191, Table 2.
5	EPA/600/4-86-030. (Source of analytical interferences)
6	EPA/600/4-86/022. (Source of analytical interferences)

TECHNICAL QUESTION 3: BASED ON POTENTIAL PATHWAYS TO THE PUBLIC AND WORKER SAFETY IMPACTS, WHAT MEDIA SHOULD BE MONITORED?

TECHNICAL APPROACH

- EVALUATE POTENTIAL PATHWAYS TO IDENTIFY MEDIA TO BE MONITORED AND THE RADIONUCLIDES TO BE CONSIDERED IN THE ANALYSIS.

- MONITOR THE FOLLOWING MEDIA:
  - AIR (PARTICULATES, NOBLE GAS, IODINE, AND RADON/ PROGENY)
  - WATER (GROUND, SURFACE, EPHEMERAL STREAMS, AND SEDIMENTS)
  - SOIL (DRIFT WALL)
  - BIOTA (ANIMAL FORAGE, INDICATOR SPECIES, AND OTHER BASED ON ECOLOGICAL AND SOCIOECONOMIC DATA COLLECTION)
  - AMBIENT RADIATION (TLDs, ION CHAMBERS, IN-SITU GAMMA SPECTROSCOPY, PUBLIC DOSIMETRY, AND AERIAL SURVEYS)

RMP ACTIVITIES

ACTIVITY	NEAR-FIELD (16 km) YMPO	FAR FIELD (15-84 km) YMPO	FAR FIELD (15-84km) EPA
CONTINUOUS AIR SAMPLERS (CAS)	9	5	14
(WEEKLY)		7 ON NTS	0
PARTICULATE SIZE (INTERMITTENT)	VARIOUS	0	0
INERT GAS/TRITIUM SAMPLERS (WEEKLY)	1	0	17
RADON MONITORING PASSIVE (QUARTERLY)	16	0	0
RADON MONITORING (CONTINUOUS)	3	0	0
WATER SAMPLING (SURFACE)	2	3	24
(ANNUALLY/AS AVAILABLE)	4E		
WATER SAMPLING (GROUND)	1	2	35
(ANNUALLY/AS AVAILABLE)	BOWS		
SEDIMENT SAMPLING (ANNUALLY)	6	3	24
SOIL DRIFT SAMPLING* (ANNUALLY AT CAS LOCATIONS; ONCE AT ALL)	54	ALL LOCATIONS	
BIOTA SAMPLING			
MILK (MONTHLY)	0	0	27
INDICATOR SPECIES (SEMIANNUALLY)	6	0	0
FORAGE/VEGETATION (BIANNUALLY)	6	0	0
OTHER (ANNUALLY)	0	TBD	TBD
AMBIENT RADIATION (QUARTERLY)	29	35	86
AMBIENT RADIATION (CONTINUOUS)	1	2	14
AERIAL SURVEY (ONCE)	1	0	0
PUBLIC MONITORING	NO	TBD	YES

* = INCLUDES IN SITU GAMMA SPECTROSCOPY AND SOILS COLLECTED FOR ARCHIVING
E = EMPHERAL STREAM BOWS = BASED ON WELL SAMPLING
TBD = TO BE DETERMINED

NWRADA5P.A29/4-24-90

TECHNICAL QUESTION 4: WHAT EQUIPMENT SHOULD BE USED AND WHERE SHOULD IT BE LOCATED?

TECHNICAL APPROACH

- NRC AND DOE GUIDANCE DOCUMENTS (MEDIA- AND CIRCUMSTANCE-SPECIFIC) ARE USED TO DEFINE THE MINIMUM ACCEPTABLE CHARACTERISTICS OF THE EQUIPMENT AND MONITORING GRID

- TECHNICAL GUIDANCE DOCUMENTS (MEDIA- AND CIRCUMSTANCE-SPECIFIC) ARE THEN USED TO ASSURE THE EQUIPMENT SELECTED IS APPROPRIATE, AND TO EXPAND THE GRID CONSISTENT WITH GOOD TECHNICAL PRACTICES

TECHNICAL APPROACH (CONTINUED)

- RELIABLE EQUIPMENT APPROACHING STATE-OF-THE-ART IS USED AS APPROPRIATE
- WITHIN THE LIMITATION SPECIFIED ABOVE, THE MONITORING PROGRAM ATTEMPTS TO BE CONSISTENT WITH CURRENT EPA MONITORING SYSTEM FOR NTS

  NOTE: SINCE THIS IS MEDIA- AND CIRCUMSTANCE-SPECIFIC AN EXAMPLE OF THE BASIS FOR SELECTION OF THE AIR SAMPLE LOCATIONS IS PROVIDED

FACTORS UTILIZED IN LOCATING AIR SAMPLERS

1. THE EXISTING POTENTIAL SOURCES OF RADIOACTIVITY TO THE NORTH AND EAST OF THE YUCCA MOUNTAIN SITE FROM DOE DEFENSE PROGRAMS AND PAST ACTIVITIES

2. THE PREVALENT WIND DIRECTIONS (BASED ON THE WIND ROSE AT THE POTENTIAL REPOSITORY SITE), WITH WINDS PREDOMINANTLY FROM THE NW TO N AND S TO SSE

3. THE MAJOR AGRICULTURAL AREA IN THE SECTION FROM SSE TO SW OF THE SITE (EPASS)

4. THE TOPOGRAPHY OF THE NEAR FIELD AREA

FACTORS (CONTINUED)

5. THE POPULATION DISTRIBUTION OF THE IMMEDIATE AREA (MOST OF THE POPULATION WITHIN 84 KILOMETERS OF THE SITE IS LOCATED ON OR SOUTH OF U.S. HIGHWAY 95)

6. SIGNIFICANT PRESENT AND FUTURE YUCCA MOUNTAIN PROJECT ACTIVITIES IN THE AREA

7. THE LOCATION OF THE EXISTING PSCRMP AIR SAMPLING STATION AND THE AIR SAMPLING STATION ASSOCIATED WITH THE WEAPONS TESTING PROGRAM

8. LOCATION OF EXISTING POWER AND METEOROLOGICAL STATIONS

9. THE POTENTIAL FUTURE RADIONUCLIDE RELEASE POINTS WILL BE IN THE EXPLORATORY SHAFT AREA AND THE FACILITY AREA FOR THE FINAL DESIGN

TECHNICAL QUESTION 5: WHAT ARE CURRENT AND POTENTIAL IMPACTS OF SITE CHARACTERIZATION ACTIVITIES ON THE PUBLIC?

TECHNICAL APPROACH

- DOSES HAVE BEEN LESS THAN 1 MREM PER YEAR FROM PRESENT ACTIVITIES
- TO DATE NO SIGNIFICANT INCREASE IS PROJECTED DURING SITE CHARACTERIZATION
- MONITORING WILL BE IMPLEMENTED
- CURRENT RESULTS INDICATE RADIONUCLIDE SOURCE IS PRIMARILY NATURAL (SOME INDICATION OF THE PRESENCE OF MAN-MADE RADIONUCLIDES AT OR BELOW MDA)
- ANALYTICAL CAPABILITY IS BEING EXPANDED AND IMPROVED (WILL ADDRESS ALL RADIONUCLIDES IDENTIFIED IN THE RADMP AS A FUNCTION OF MEDIA)

TOTAL QUALITY PROGRAM

- AS TECHNICAL DATA COLLECTION AND QUALITY ASSURANCE METHODOLOGY IMPROVEMENTS HAVE DEVELOPED, THE RADIOLOGICAL MONITORING PROGRAM HAS EVOLVED NEW PROCEDURES TO RETAIN CURRENCY

- RADIOLOGICAL DATA COLLECTION HAS BEEN CONSISTENT WITH ALL QUALITY ASSURANCE REQUIREMENTS

- RADIOLOGICAL PROTECTION AND DATA COLLECTION PROGRAM IS BEING REVISED TO ASSURE CONSISTENCY WITH UPDATED QUALITY PROGRAM, THE REVISED RADMP, CURRENT TECHNICAL GUIDANCE AND NEW INDUSTRY PRACTICE (E.G. INPO GUIDANCE)

- CONSIDERATION OF UPGRADING OF THE TLD PROGRAM CONSISTENT WITH NIST SYSTEMS

- REPLACING TRACK ETCH MATERIALS WITH E-PERMS FOR RADON MONITORING BASED ON QC EVALUATIONS

STATUS AND ACCOMPLISHMENTS

- NEAR FIELD ACTIVITIES INITIATED 9/87 (ONE AIR SAMPLING LOCATION AND 7 RADON MONITORING LOCATIONS) TERMINATED 9/88 AND PROJECTED TO BE RESUMED 5/90 PENDING ISSUANCE OF REVISED PROCEDURES

- FAR FIELD SAMPLING ACTIVITIES (WITH THE EXCEPTION OF NOBLE GAS MONITORING) IS ONGOING (37 STATIONS ESTABLISHED AND 33 JOINT-USAGE STATIONS IDENTIFIED)

- IMPLEMENT FULL RADIOLOGICAL MONITORING PROGRAM BY 1/91

STATUS AND ACCOMPLISHMENTS (CONTINUED)

- ISSUED FOLLOWING PLANS:
  - PRELIMINARY SITE CHARACTERIZATION RADIOLOGICAL MONITORING PLAN FOR THE NEVADA NUCLEAR WASTE STORAGE INVESTIGATIONS PROJECT YUCCA MOUNTAIN SITE (DOE/NV/10270-14) (3/87)
  - SAFETY PLAN FOR METEOROLOGICAL AND RADIOLOGICAL MONITORING ACTIVITIES (DOE NV/10270-13) (2/87)
  - RADIOLOGICAL MONITORING PLAN FOR THE NNWSI PROJECT (NNWSI/88-14) (3/88)
  - ENVIRONMENTAL FIELD ACTIVITY PLAN FOR RADIOLOGICAL STUDIES (DOE/NV-10576-12) (8/88)
- DEVELOPED
  - ENVIRONMENTAL RADIOLOGICAL MONITORING TRAINING PROGRAM AND FIVE ASSOCIATED TRAINING MODULES (12/86)

STATUS AND ACCOMPLISHMENTS (CONTINUED)

- INITIATED RADIOLOGICAL MONITORING ACTIVITIES (9/87)
- ESTABLISHED FIELD OPERATIONS SUPPORT FACILITIES FOR THE RADIOLOGICAL AND METEOROLOGICAL MONITORING PROGRAM IN AREA 25 AT NTS
- DEVELOPED TECHNICAL DATA AND ANALYSIS REPORTS

INTERDISCIPLINARY INTERACTIONS

- METEOROLOGICAL DATA REQUIRED TO ESTABLISH AND INTERPRET MONITORING DATA
- AIR QUALITY MONITORING PROGRAM PROVIDES CONFIRMATION DATA FOR THE RADIOLOGICAL PROGRAM'S PARTICLE SIZE DATA COLLECTION ACTIVITIES
- TERRESTRIAL ECOSYSTEM PROGRAM PROVIDES IDENTIFICATION OF INDIGENOUS BIOTA IN THE PATHWAYS OF INTEREST AND COLLECTS BIOTA SAMPLES
- SOCIOECONOMICS PROGRAM PROVIDES DATA FOR ASSESSMENT OF IMPACTS, POPULATION DISTRIBUTIONS, AND THE IDENTIFICATION OF AGRICULTURAL AND OTHER PATHWAYS TO HUMANS

INTERACTIONS (CONTINUED)

- SITE-CHARACTERIZATION HYDROLOGY PROGRAM AND THE WATER RESOURCES MONITORING PROGRAMS PROVIDE MOST OF THE WATER SAMPLES FOR THE CHARACTERIZATION OF THE GROUND WATER

- SITE-CHARACTERIZATION HYDROLOGY PROGRAM PROVIDES THE MODEL FOR PREDICTING THE BEHAVIOR OF GROUND WATER AND THE TRANSPORT OF RADIONUCLIDES BY GROUND WATER

- ARCHAEOLOGICAL MONITORING PROGRAM PROVIDES DATA ON THE LOCATION OF LOCAL CATCH BASINS

- U. S. GEOLOGICAL SURVEY WILL BE PROVIDING DATA ON THE RADIONUCLIDE CONTENT OF ROCKS, SOILS, GROUND WATER AND OTHER MATERIALS, AS APPROPRIATE

- METEOROLOGICAL MONITORING, TERRESTRIAL ECOSYSTEM PROGRAM, AND RADIOLOGICAL MONITORING PROGRAM SHARE FACILITIES AND EQUIPMENT, AS APPROPRIATE