LA-UR-00-3854

The Omega West Reactor and Water Boiler Building, TA-2-1;
A Preliminary Report

Historic Building Survey Report No. 186

Los Alamos National Laboratory

August 14, 2000
Survey No. 814

Prepared for the Department of Energy
Los Alamos Area Office

prepared by

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And
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Cultural Resource Managers

ESH-20 Cultural Resources Team
Environment, Safety, and Health Division
LOS ALAMOS NATIONAL LABORATORY

Introduction:

The following information has been prepared as part of the notification of an adverse effect to TA-2-1, a historic LANL property. The proposed removal action (detailed below) stems from an increased risk of severe flooding in the aftermath of the Cerro Grande fire.

Background Information:

Physical Description – Omega Site and Building TA-2-1

Technical Area (TA) 2, Omega Site, is a small technical area located in the bottom of Los Alamos Canyon, Los Alamos, New Mexico. This technical area consists of a single main building (TA-2-1). In recent months, other support structures located at this abandoned facility have been removed. TA-2-1 has housed five nuclear reactors between 1944 and 1994. The eastern half of TA-2-1, a wooden building with a high bay, was constructed in 1944. The western half is a two-story addition that was built in 1946 out of concrete block (see-attached map, photos and drawings).

Brief Historical Background

The eastern half of TA-2-1 was built in 1944 during the Manhattan Project at Los Alamos. It was originally known as the Water Boiler building because it was built to house the first water boiler reactor, LOPO (low-powered). This reactor was the world's third reactor. It was also the first homogeneous liquid-fueled reactor and the first reactor to be fueled by enriched Uranium-235. LOPO produced the first self-sustaining nuclear chain reaction using enriched uranium on May 9, 1944. The original use of this reactor was for critical mass calculations in support of the first uranium bomb. A higher power version of this reactor was eventually needed to serve as a source of neutrons that would roughly represent the neutron spectrum from an atomic weapon (Garcia 1999).

LOPO was dismantled and a second water boiler reactor was functioning by the end of 1944. This second reactor, HYPO (high-powered), was operated until 1951, when HYPO was converted into SUPO (super-powered). This version was in operation until 1974, when it was deactivated. SUPO's neutrons were used for many measurements important to the national weapons program (Garcia 1999). The Water Boiler portion of TA-2-1 also contained office spaces, other general laboratory space, and a vault for the storage of fuel rods. In 1990, the American Nuclear Society declared the Los Alamos Water Boiler Reactor (1944 – 1974) to be a Nuclear Historic Landmark. A plaque commemorating this declaration was placed on the wall of the former control room in the Water Boiler portion of TA-2-1.

In 1946, the "Clementine" Reactor was constructed in a new addition to the Water Boiler building. This reactor was a fast-neutron research reactor that used plutonium fuel surrounded by mercury coolant. Clementine was the world's first fast plutonium-fueled reactor and it reached full operational power in 1949. This reactor's fast neutrons were

used in weapons experiments. In 1952, Clementine was shut down after a fuel element failure contaminated the mercury coolant with plutonium. The reactor was dismantled in 1954 (Garcia 1999).

The final reactor at the Omega Facility, the Omega West Reactor, was built on the foundations of Clementine in the western half of TA-2-1. This water-cooled research reactor went critical in 1956. The Omega West Reactor was designed primarily to facilitate experimentation in nuclear physics and other sciences. The largest single use of this reactor was neutron activation analysis. The Omega West Reactor was shut down in 1992 when a leak was discovered. Omega Site has been closed since 1995 (Garcia 1999).

Daghlian Criticality Accident

On August 21, 1945, a critical assembly was being created at Omega Site by hand stacking tungsten-carbide bricks around a plutonium core. When the researcher, Harry Daghlian, moved the final brick over the assembly, he noticed that the addition of the brick would make the assembly supercritical. The brick slipped and fell onto the assembly and the system became super-prompt critical. Daghlian removed the brick and unstacked the assembly. The power excursion gave him an exposure of approximately 510 rem and he died 28 days later (Stratton rev. Smith 1989).

Potential for Contamination

At TA-2-1, contaminated areas in the Omega West Reactor portion of the building include the top of the reactor tank and the roof above the reactor tank. The Water Boiler portion of the building is also contaminated: the concrete-capped floor of room 123 (where the LOPO reactor was located), other areas in room 123, and areas in room 122 (where the HYPO and SUPO reactors were located) (Garcia 1999).

Principal radionuclides normally remaining in reactor cooling water systems are tritium and cobalt 60. Other possible contaminates from the operations of the Omega West Reactor and other reactors include cesium-137, technetium-99, mercury, chromium, and total uranium and isotopic plutonium (Garcia 1999).

Eligibility Recommendation:

The Water Boiler reactors at TA-2-1 provided critical mass data in support of Manhattan Project nuclear weapons development. The three Water Boiler reactors and the later Clementine reactor were prototype nuclear reactors and represent important stages in the development of modern reactor technology. For these reasons, TA-2-1 is considered a historically significant property and is eligible under Criterion A. The property is considered eligible although it has suffered a loss of interior integrity from past cleanup activities, especially in the Water Boiler portion of the building where none of the water boiler reactor equipment remains.

***Proposed Removal Action*:**

Both halves of TA-2-1 will be decontaminated, decommissioned, and completely removed at the completion of this project. TA-2-1 is being considered for removal because severe flooding in Los Alamos Canyon could release radiological contamination from the building into the environment, causing a threat to human health. The risk of flooding at TA-2 has increased dramatically as a result of the Cerro Grande Fire and projected runoff in the canyon during a 100-year storm event is predicted to be in excess of 2180 cubic feet per second. These values are approximately four times the flows expected for a 100-year storm before the fire.

References Cited:

Kari L. M. Garcia

1999 *Decontamination and Decommissioning of Structure 49 and Buildings 57 and 88 at Technical Area 2.* LA-UR-99-798, Historic Building Survey Report No. 162. On file at ESH-20, Los Alamos National Laboratory, Los Alamos, New Mexico.

Stratton, W., rev. by D. Smith

1989 *A Review of Criticality Accidents.* Published by Nuclear Criticality Information System, U.S. Department of Energy, Office of Safety Appraisals, DOE/NCT-4, (originally published in 1967 by then LASL, now LANL).

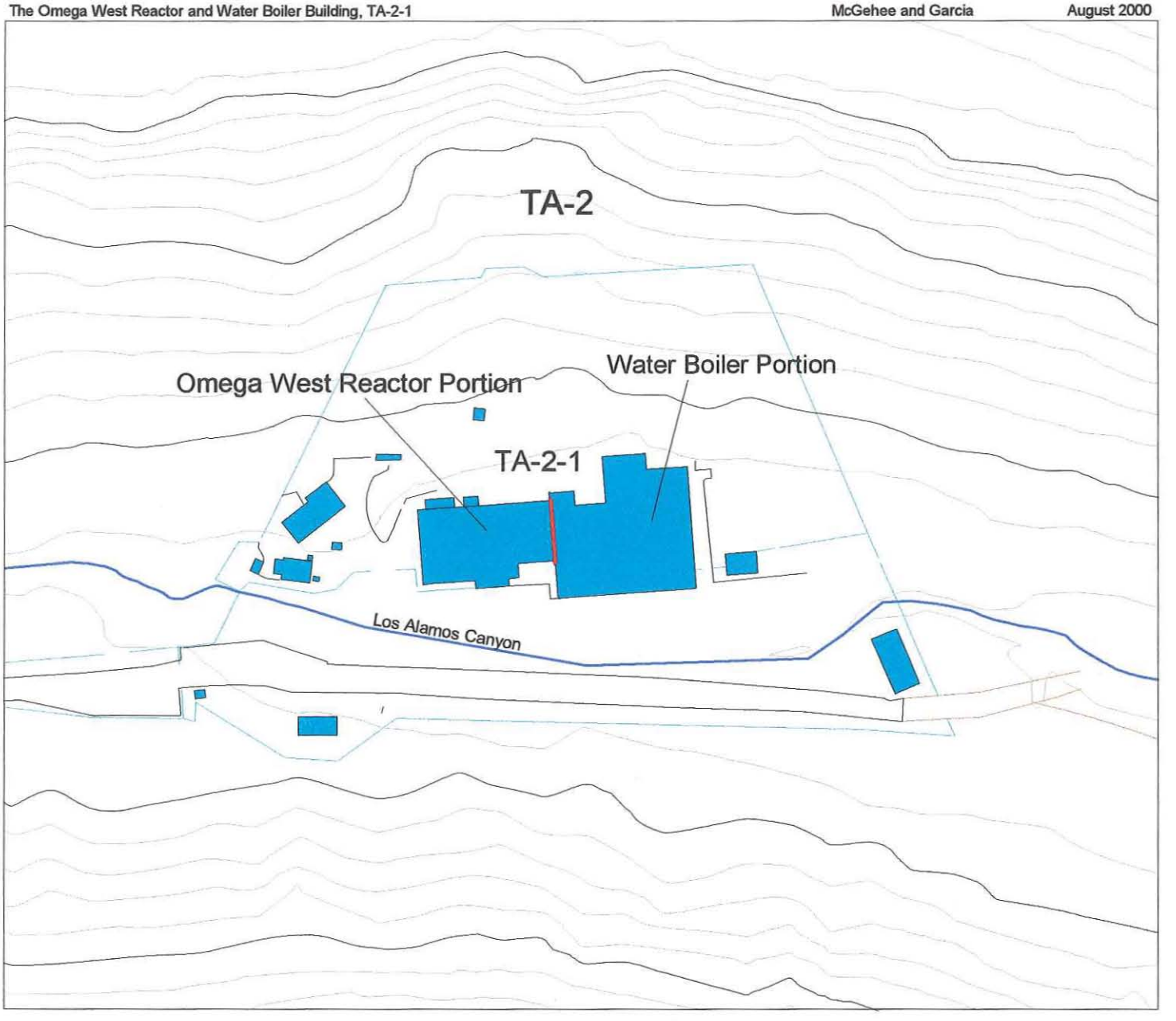
The following references contain additional information about early Manhattan Project criticality studies:

Hoddeson, Lillian, Paul W. Henriksen, Roger A. Meade, and Catherine Westfall

1997 *Critical Assembly; A Technical History of Los Alamos during the Oppenheimer Years, 1943-1945.* Cambridge University Press, Cambridge, UK. Copyrighted by the U.S. Department of Energy, 1993. First published 1993, reprinted 1995 and 1997, and digitally printed 1998.

Hawkins, D., E. Truslow, and R. Smith

1983 "Project Y, The Los Alamos Story" in *The History of Modern Physics, 1800-1950, Vol. 2.* Tomash Publishers.



1:1500

20 0 20 40 60 Meters

100 0 100 200 Feet

Los Alamos
National Laboratory

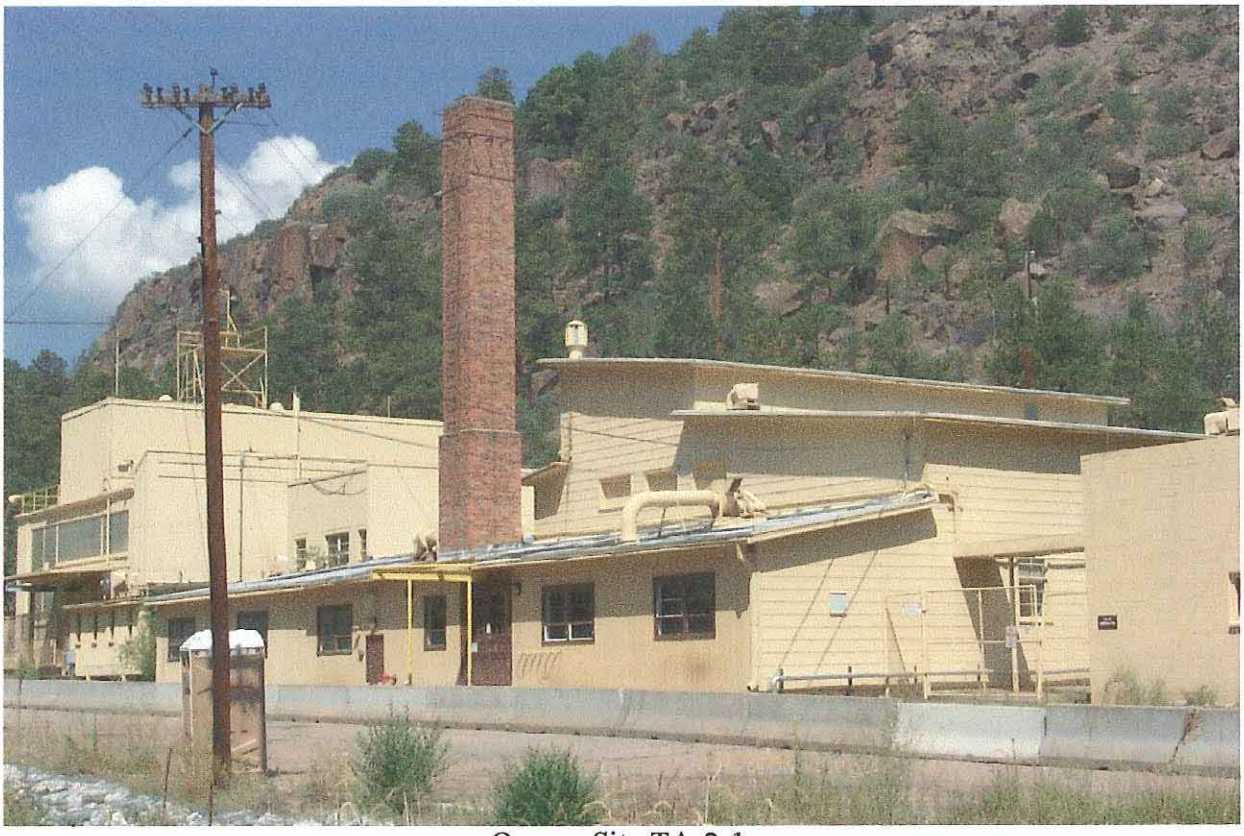
Cultural Resources Team
ESH-20 Ecology Group

N
W E
S

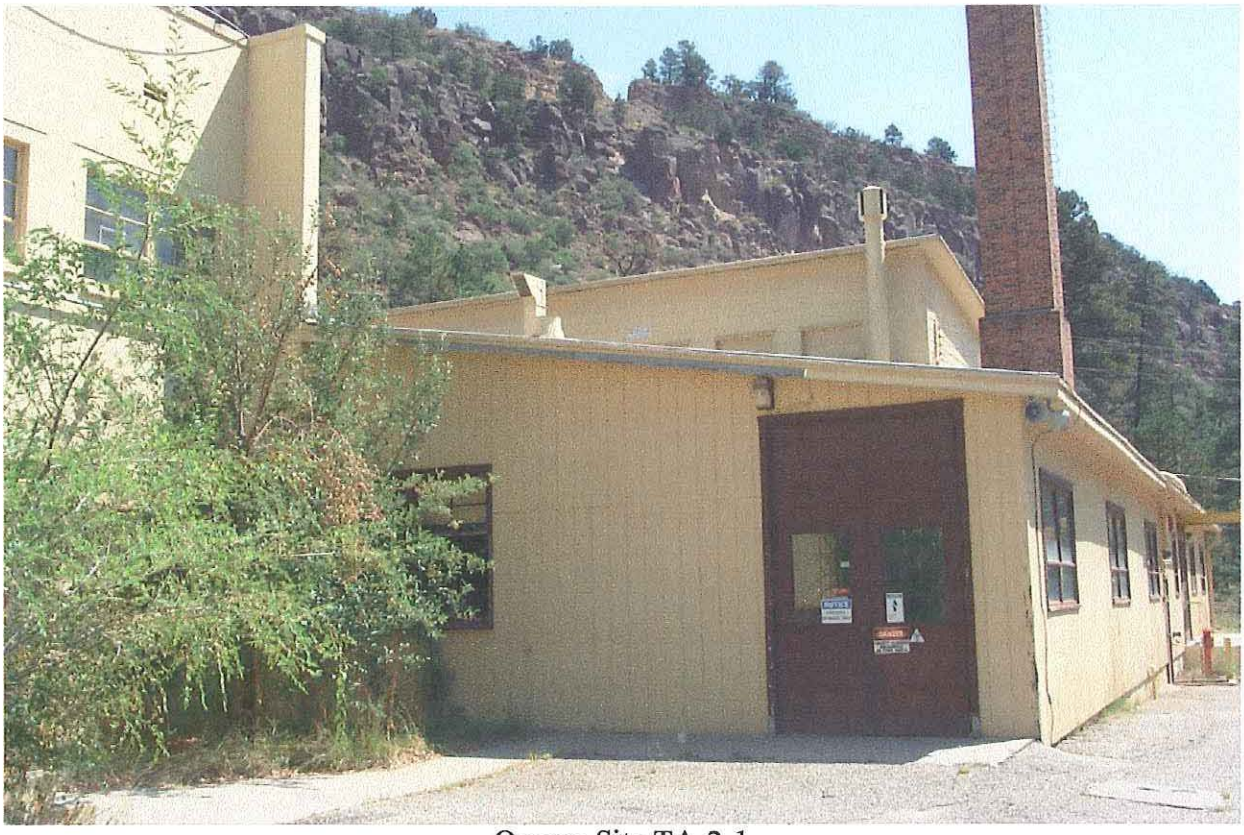
20 Foot Contours
100 Foot Contours
Drainage
Roads
Roaddirt
Parkpave
Parkdirt
Fences
Permbldg

TA-2 Omega Site

Building TA-2-1



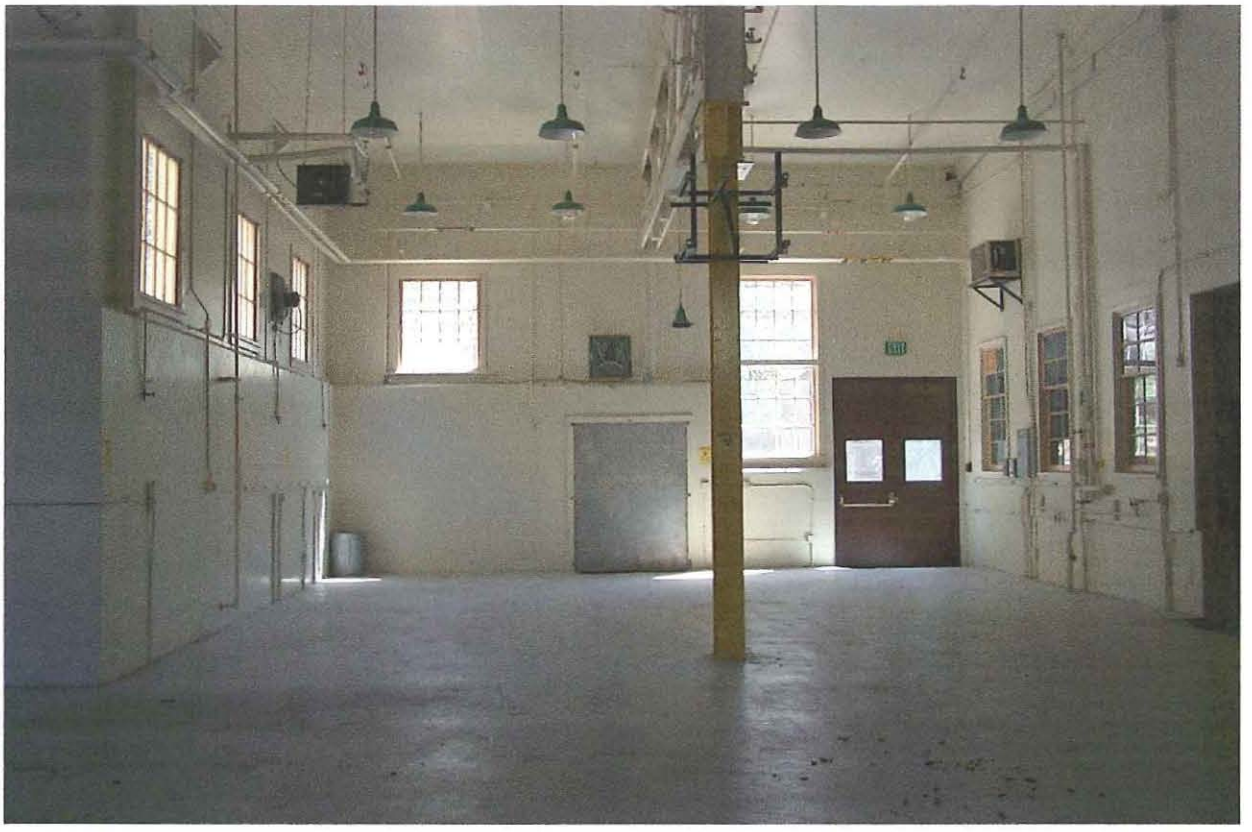
Omega Site TA-2-1



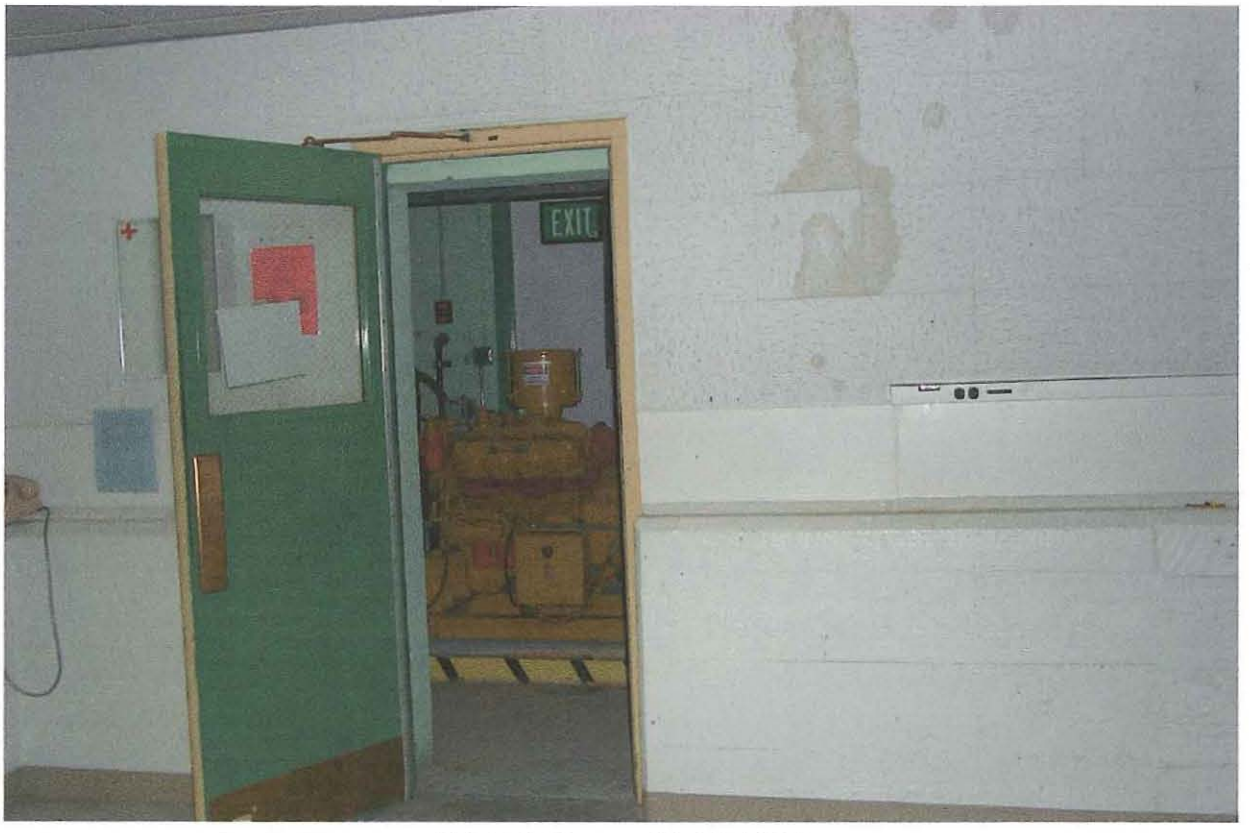
Omega Site TA-2-1

TA-2-1, Room 122

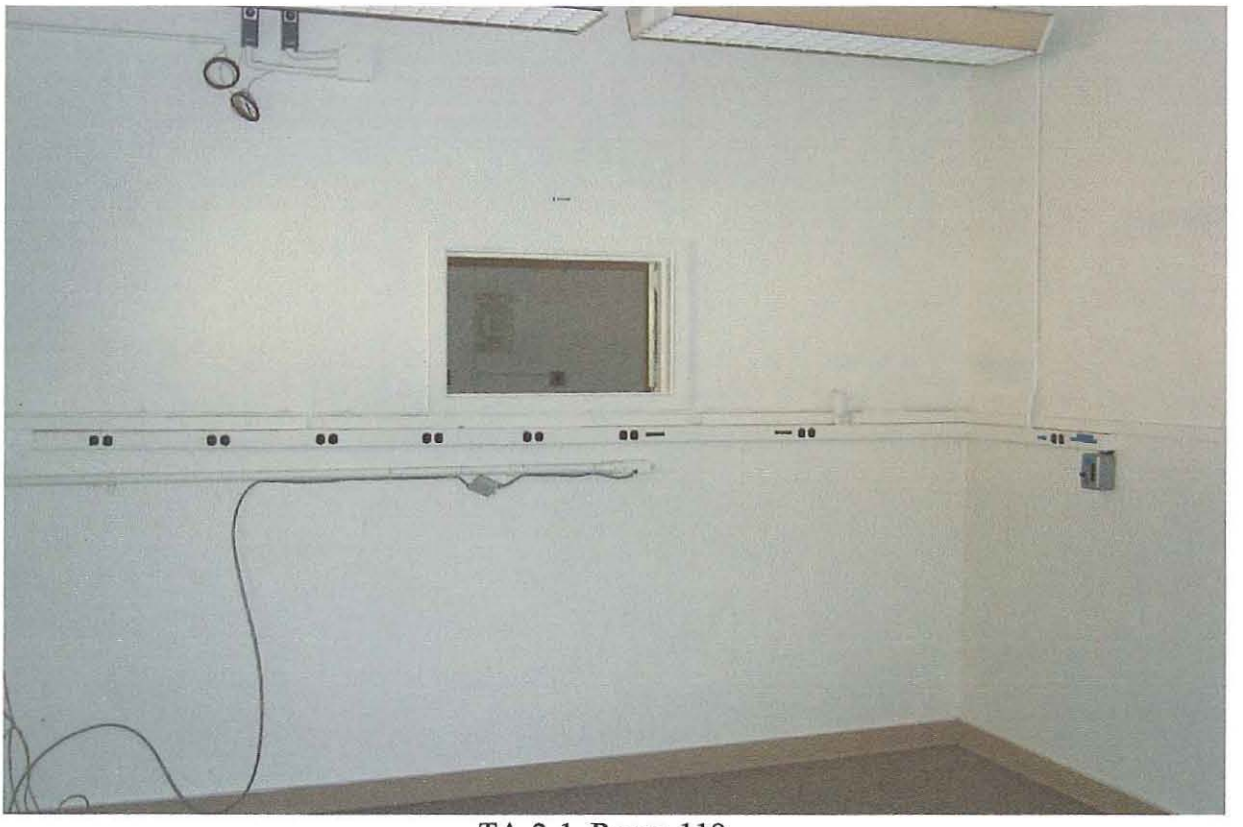
TA-2-1, Room 122



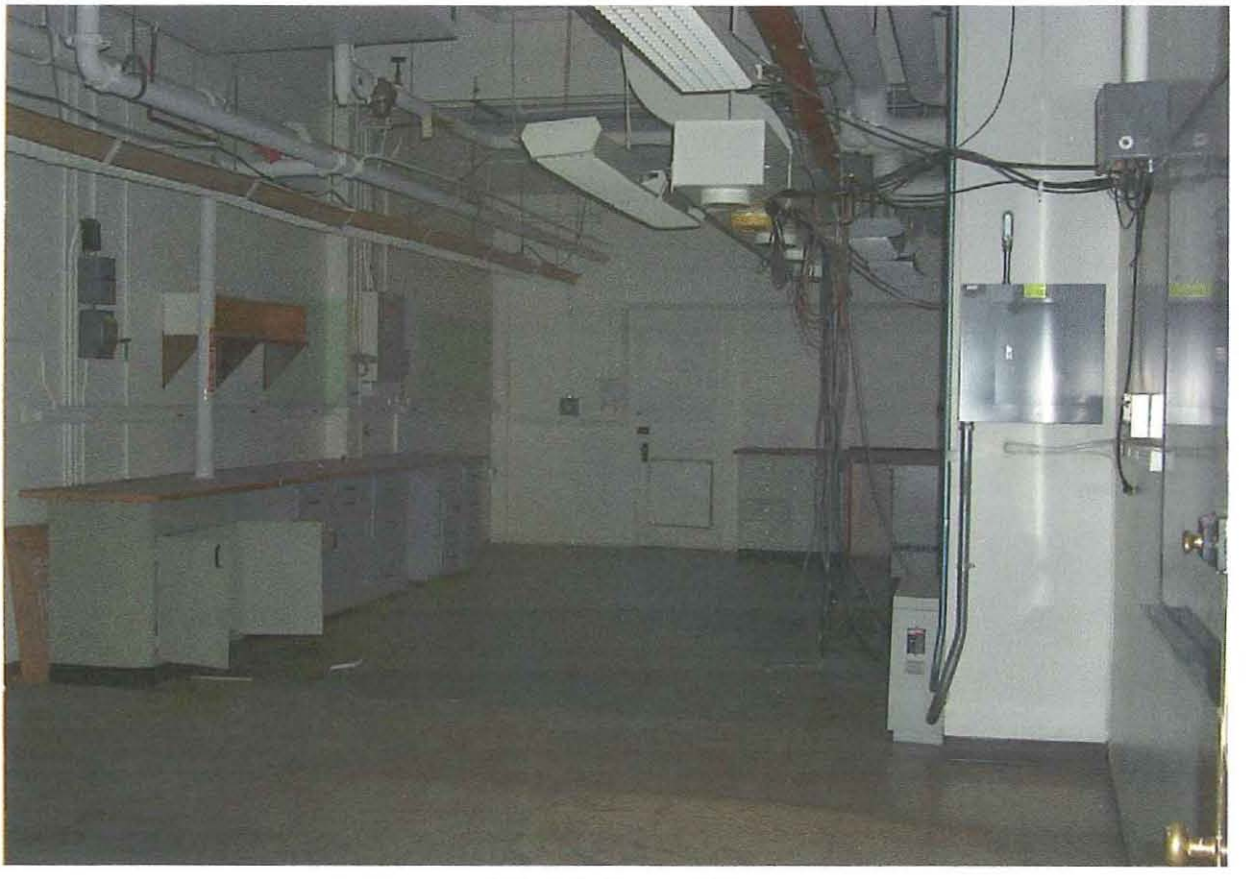
TA-2-1, Room 122



TA-2-1, Rooms 116 & 116A



TA-2-1, Room 119



TA-2-1, Room 121

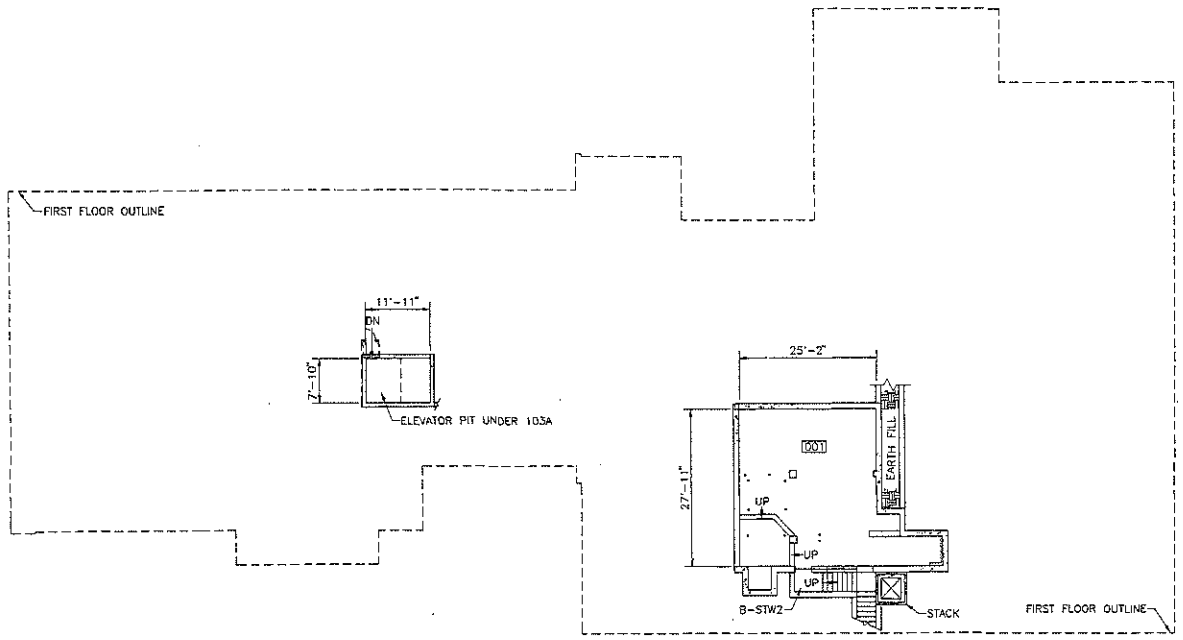
TA-2-1, Room 123

TA-2-1, Room 123

ROOM INFORMATION CHART	
ROOM NUMBER	NET SQUARE FOOTAGE
001	805
ELEV/PIT	94
B-STW2	47

TOTAL ROOM NET SQUARE FOOTAGE = 946

GROSS SQUARE FOOTAGE = 1,123



BASEMENT FLOOR PLAN

SCALE: 3/32" = 1'-0"

12 9 6 3 0 12 24 48

GRAPHIC SCALE

N

LEGEND

CONCRETE

COLUMNS

BRICK

NOTES

1. ROOM NET SQUARE FOOTAGE IS COMPUTED BY MEASURING FROM THE INSIDE FACE OF EXTERIOR WALLS TO THE CENTERLINE OF ALL OTHER WALLS.
2. GROSS SQUARE FOOTAGE IS EQUAL TO ALL FLOOR AREA (INCLUDING ALL OPENINGS IN FLOOR SLABS) MEASURED TO THE OUTER SURFACES OF EXTERIOR OR ENCLOSING WALLS, AND INCLUDES ALL FLOORS, MEZZANINES, HALLS, VESTIBULES, STAIRWELLS, SERVICE AND EQUIPMENT ROOMS, PENTHOUSES, ENCLOSED PASSAGES AND WALKS, FINISHED USABLE SPACE WITH SLOPING CEILINGS (SUCH AS ATTIC SPACES) HAVING 5 FEET OR MORE HEADROOM, AND APPENDED COVERED SHIPPING OR RECEIVING PLATFORMS AT TRUCK OR RAILROAD CAR HEIGHT. ALSO INCLUDED IN GROSS FLOOR AREA, BUT CALCULATED ON ONE-HALF OF ACTUAL FLOOR AREA, ARE COVERED OPEN PORCHES, PASSAGES AND WALKS, WITH APPENDED UNCOVERED RECEIVING AND SHIPPING PLATFORMS AT TRUCK AND RAILROAD HEIGHT.

NO	DATE	CLASS REV	DESCRIPTION	DWN	VER	CHKD	REL	SUB	REC	APP

MF

JOHNSON CONTROLS WORLD SERVICES INC.

AS-BUILT RECORD FLOOR PLAN
LABORATORY AND OFFICE BUILDING
ARCH: BASEMENT FLOOR PLAN

DRAWN C. SANDOVAL
VERIFIED C.S.S.
CHECKED C. SANDOVAL
RELEASED H. SALAZAR
DATE 10-27-93

BLDG 01 TA-02

SUBMITTED JERRY FORTE
RECOMMENDED FRED THOMPSON 10/1/93
APPROVED FRED THOMPSON 10/5/93

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

SHEET 1 OF 3

CLASSIFICATION U REVIEWER H. SALAZAR DATE 10-4-93

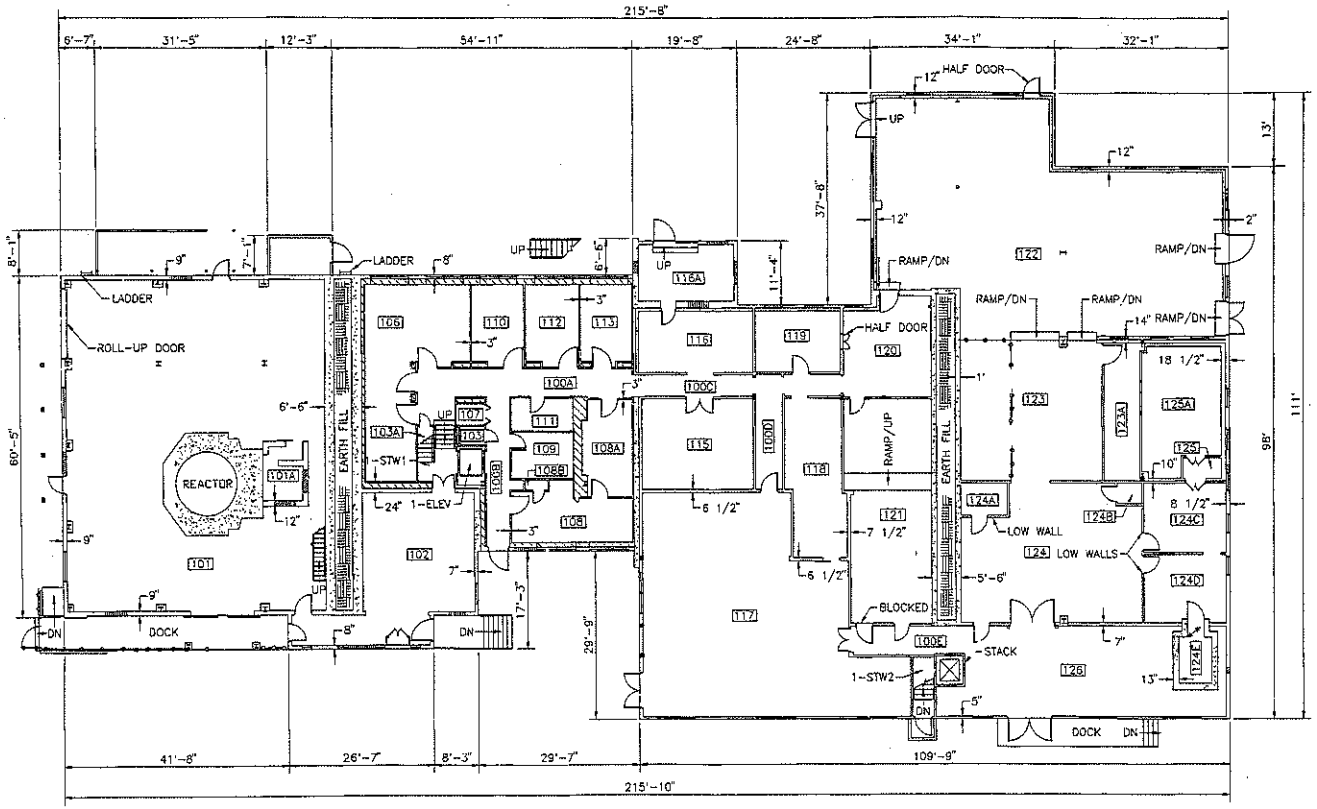
PROJECT ID 7556

DRAWING NO. AB119

REV

FIELD VERIFIED 09-27-93

110-16 ON 10



FIRST FLOOR PLAN

SCALE: 3/32" = 1'-0"

GRAPHIC SCALE 12 9 6 3 0 12 24 48

N

FIELD VERIFIED 09-14-93

ROOM INFORMATION CHART

RM NO	NET SQUARE FOOTAGE	RM NO	NET SQUARE FOOTAGE
100A	251	116A	200
100B	130	117	1,540
100C	164	118	310
100D	85	119	179
100E	115	120	335
101	2,913	121	278
101A	85	122	2,230
102	680	123	737
103	17	123A	181
103A	11	124	529
105	623	124A	71
107	44	124B	20
108	205	124C	196
108A	170	124D	182
108B	9	124E	72
109	97	125	31
110	145	125A	335
111	69	126	777
112	145	1-STW1	69
113	146	1-STW2	48
115	354	1-ELEV	41
116	263	UTILITY	152

TOTAL ROOM NET SQUARE FOOTAGE = 15,997

GROSS SQUARE FOOTAGE = 16,554

LEGEND

- CONCRETE
- CONCRETE BLOCK
- LOUVER
- WOOD OR METAL STUD
- WINDOW
- COLUMNS
- WIRE MESH PARTITION
- I BEAM
- BRICK
- 3" METAL PARTITION
- UTILITY

NOTES

1. ALL INTERIOR WALLS ARE 4 1/2" THICK UNLESS OTHERWISE NOTED.
2. REFERENCE DRAWINGS ENG-C1623, ENG-C1674, AND ENG-R3333.
3. ROOM NET SQUARE FOOTAGE IS COMPUTED BY MEASURING FROM THE INSIDE FACE OF EXTERIOR WALLS TO THE CENTERLINE OF ALL OTHER WALLS.
4. GROSS SQUARE FOOTAGE IS EQUAL TO ALL FLOOR AREA (INCLUDING ALL OPENINGS IN FLOOR SLABS) MEASURED TO THE OUTER SURFACES OF EXTERIOR OR ENCLOSING WALLS, AND INCLUDES ALL FLOORS, MEZZANINES, HALLS, VESTIBULES, STAIRWELLS, SERVICE AND EQUIPMENT ROOMS, PENTHOUSES, ENCLOSED PASSAGES AND WALKS, FINISHED USABLE SPACE WITH SLOPING CEILINGS (SUCH AS ATTIC SPACES) HAVING 5 FEET OR MORE HEADROOM, AND APPENDED COVERED SHIPPING OR RECEIVING PLATFORMS AT TRUCK OR RAILROAD CAR HEIGHT. ALSO INCLUDED IN GROSS FLOOR AREA, BUT CALCULATED ON ONE-HALF OF ACTUAL FLOOR AREA, ARE COVERED OPEN PORCHES, PASSAGES AND WALKS, WITH APPENDED UNCOVERED RECEIVING AND SHIPPING PLATFORMS AT TRUCK AND RAILROAD HEIGHT.

NO	DATE	CLASS/REV	DESCRIPTION	DWN	VER	CHKD	REL	SUB	REC	APP

JOHNSON CONTROLS WORLD SERVICES INC.

AS-BUILT RECORD FLOOR PLAN
LABORATORY AND OFFICE BUILDING
ARCH: FIRST FLOOR PLAN

DRAWN C. SAMORA
VERIFIED C.E.S./C.D.S.
CHECKED C. SANDOVAL
RELEASED H. SALAZAR
DATE 10-27-93

BLDG 01 TA-02

SUBMITTED JERRY FORTE
RECOMMENDED FRED THOMPSON
APPROVED FRED THOMPSON

Los Alamos — Los Alamos National Laboratory, Los Alamos, New Mexico 87545

SHEET 2 OF 3

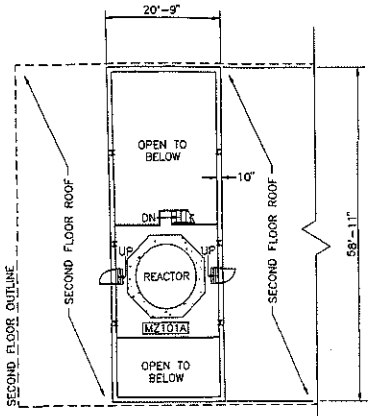
CLASSIFICATION U REVIEWER REVIEWER DATE 12-14-93

PROJECT ID 7556

DRAWING NO AB119

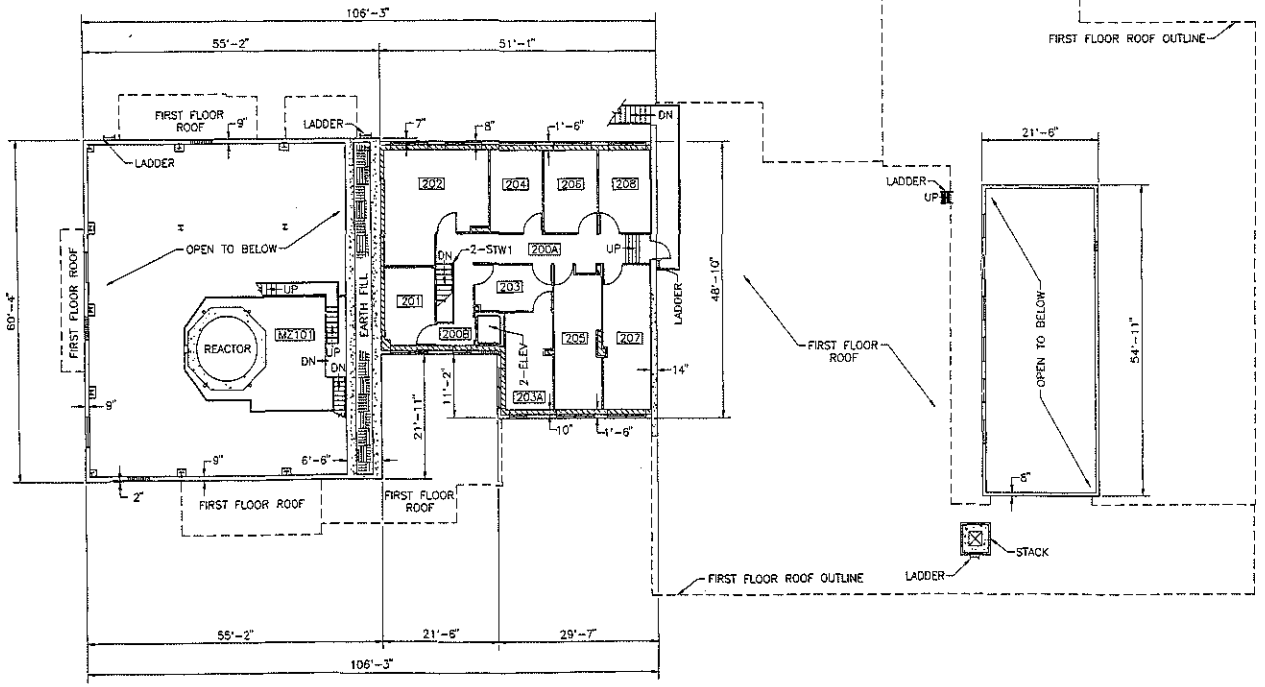
REV

ECI NO 91-011



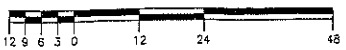
MEZZANINE 101A ABOVE MZ101

SCALE: 3/32" = 1'-0"



SECOND FLOOR PLAN

SCALE: 3/32" = 1'-0"



ROOM INFORMATION CHART

RM NO	NET SQUARE FOOTAGE	RM NO	NET SQUARE FOOTAGE
200A	182	206	149
200B	110	207	226
201	131	208	142
202	341	MZ101	425
203	121	MZ101A	380
203A	142	2-STW1	33
204	148	2-ELEV	35
205	219	UTILITY	135

TOTAL ROOM NET SQUARE FOOTAGE = 2,927

GROSS SQUARE FOOTAGE = 7,969

LEGEND

- CONCRETE
- CONCRETE BLOCK
- WINDOW
- COLUMNS
- I BEAM
- BRICK
- 3" METAL PARTITION
- WOOD AND METAL PARTION
- UTILITY
- LOUVER

NOTES

1. ALL INTERIOR WALLS ARE 3" THICK UNLESS OTHERWISE NOTED.
2. REFERENCE DRAWINGS ENG-R3334 AND ENG-C1725.
3. ROOM NET SQUARE FOOTAGE IS COMPUTED BY MEASURING FROM THE INSIDE FACE OF EXTERIOR WALLS TO THE CENTERLINE OF ALL OTHER WALLS.
4. GROSS SQUARE FOOTAGE IS EQUAL TO ALL FLOOR AREA (INCLUDING ALL OPENINGS IN FLOOR SLABS) MEASURED TO THE OUTER SURFACES OF EXTERIOR OR ENCLOSING WALLS, AND INCLUDES ALL FLOORS, MEZZANINES, HALLS, VESTIBULES, STAIRWELLS, SERVICE AND EQUIPMENT ROOMS, PENTHOUSES, ENCLOSED PASSAGES AND WALKS, FINISHED USABLE SPACE WITH SLOPING CEILINGS (SUCH AS ATTIC SPACES) HAVING 5 FEET OR MORE HEADROOM, AND APPENDED COVERED SHIPPING OR RECEIVING PLATFORMS AT TRUCK OR RAILROAD CAR HEIGHT. ALSO INCLUDED IN GROSS FLOOR AREA, BUT CALCULATED ON ONE-HALF OF ACTUAL FLOOR AREA, ARE COVERED OPEN PORCHES, PASSAGES AND WALKS, WITH APPENDED UNCOVERED RECEIVING AND SHIPPING PLATFORMS AT TRUCK AND RAILROAD HEIGHT.

NO	DATE	CLASS REV	DESCRIPTION	DWN	VER	CHKD	REL	SUB	REC	APP

JOHNSON CONTROLS WORLD SERVICES INC.

AS-BUILT RECORD FLOOR PLAN
LABORATORY AND OFFICE BUILDING
ARCH: SECOND AND MEZZANINE FLOOR PLAN

DRAWN: C. SAVORA
VERIFIED: C.S./D.D.S.
CHECKED: C. SANDOVAL
RELEASED: H. SALAZAR
DATE: 10-27-93

BLDG 01 TA-02

SUBMITTED: JERRY FORTE
RECOMMENDED: FRED THOMPSON 12/14/93
APPROVED: FRED THOMPSON 12/14/93

Los Alamos — Los Alamos National Laboratory, Los Alamos, New Mexico 87545

SHEET 3 OF 3

CLASSIFICATION U REVIEWER H. SALAZAR DATE 12-19-93

PROJECT ID 7556 DRAWING NO AB119 REV

JCI NO 91-011

FIELD VERIFIED 09-14-93