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NRC FORM 195 (2-76) — U.S. NUCLEAR REGULATORY COMMISSION

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DOCKET NUMBER	50-269/270/287	
FILE NUMBER		
TO: Mr. Edson G. Case	FROM: Duke Power Company, Charlotte, North Carolina, William O. Parker, Jr.	DATE OF DOCUMENT 12/28/77
		DATE RECEIVED 1/3/78
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DESCRIPTION

Request for Commission approval for the use of the Elwood Nuclear Safety Model ENS-1560 two-piece air supplied suit for respiratory protection..w/att Report of Testing of Two Atmosphere Supplying Suits..

(1-P)+(10-P)

ENCLOSURE

1 ENCL

PLANT NAME: Oconee Units 1-2-3
RJL 1/4/78

FOR ACTION/INFORMATION

SAFETY BRANCH CHIEF: (7) SCHWENCER

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WILLIAM O. PARKER, JR.
VICE PRESIDENT
STEAM PRODUCTION

TELEPHONE: AREA 704
373-4083

December 28, 1977

Mr. Edson G. Case, Acting Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Mr. A. Schwencer, Chief
Operating Reactors Branch #1

Reference: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287

Dear Mr. Case:

Section 20.103 of 10 CFR 20, as amended on November 29, 1976, requires that respiratory protection equipment be used as stipulated in Regulatory Guide 8.15 if credit is to be taken for the protection provided by the respiratory protective equipment. Regulatory Guide 8.15 requires specific Commission authorization to use respiratory protection equipment not approved under the schedules in 30 CFR Part 11 or where there is no existing schedule for approval of such equipment.

It is therefore requested that Commission approval be granted for the use of the Elwood Nuclear Safety Model ENS-1560 two-piece air supplied suit for respiratory protection. The suit consists of a slipover jacket with a permanently attached sealed hood, positive sealing detachable gloves and pants with permanently attached, completely sealed boots and drawstring at the waist. The suit is made of .006 gauge self-extinguishing polyvinal chloride with air distribution tubing.

The suit has been tested by Los Alamos Scientific Laboratory and test results show that the material and performance characteristics of this suit are capable of providing an acceptable degree of protection under anticipated conditions of use. Test results are attached. A protection factor of 1000 would be applied during use of the suit.

Very truly yours,

William O. Parker, Jr.

LJB:vr
Attachment

REPORT OF TESTING OF TWO ATMOSPHERE SUPPLYING SUITS

Performed by

Thomas O. Davis, Jr., Philip Lowry, and Tom O. Moore

Respirator Research & Development Section
Industrial Hygiene Group
Los Alamos Scientific Laboratory
University of California
Los Alamos, New Mexico 87544

October 12, 1973

I. Testing Procedure

All tests were carried out in LASL's respirator fitting chamber.

The challenge aerosol was a polydisperse DOP aerosol, 0.75 μm aerodynamic mass median diameter (AMMD). The aerosol detector was a LASL forward light scattering photometer. Penetration samples were taken from the breathing region inside the hood.

Suit internal pressure was taken at the upper chest level. Suit pressure was indicated by a Validyne ultra-low differential pressure sensor, with one pressure tap sealed and the other pressure tap connected to the suit chest region. The pressure sensor was not calibrated, but was used to indicate relative pressures.

Three internal air temperatures were recorded. The locations were; upper chest region, forearm, and mid-calf. The leg temperature was taken from the leg being cooled by the leg air tube. The temperature sensors were Yellow Springs Instrument Company's thermistor thermometers. The thermistor probes are designed to measure air temperature only.

The supply air flowrate was measured by an orifice meter tube with a Magnehelic as the readout. The orifice tube was calibrated by connecting the tube output to one of the suits, placing the suit in a sealed container, and measuring the output from the container. Calibrations were made for each integer flowrate from 1 to 10 cfm inclusive. The calibration for each flowrate was made approximately 0.3 cfm higher then the integer flowrate recorded in order to compensate for the penetration sampling flowrate. The supply air was 73°F and 5% relative humidity before entering the suit.

A series of exercises was performed by the subject at each tested flowrate. The exercises were chosen as being basic body movements. Other movements can be taken as combinations or refinements of these movements. The exercise series was:

1. Stand, arms at sides
2. Bend at waist, touch toes
3. Run in place, lifting knees high (to simulate climbing ladders and stairs, and a heavy workload)

4. Lift arms above head, lower arms
5. Lock hands in front of chest, twist torso from side to side
6. Stand, arms at sides

The exercises were performed in the order listed. Each exercise was performed for one minute, or until the leak indication stabilized. If a leak occurred during an exercise, a purge time was allowed before beginning the next exercise. The purge time lasted until the leak indication returned to the sedentary leak levels for that flowrate.

II. Aerosol Penetration Test Results

Table I gives the percent penetrations for the tests on the Snyder suit. A "T" in a box indicates general penetration levels were so high that the test was terminated to reduce the subject's exposure.

Table II gives the percent penetrations for the tests on the Mound bubble suit, without pants' suspenders.

Table III gives the percent penetrations for the tests on the Mound bubble suit, with pants' suspenders.

The testing shown in Table III was performed because the operator observed that as the pants of the Mound suit rode lower as exercises continued, the penetrations increased. Cord suspenders were made which held the waistband of the pants as high as possible. Tests while using suspenders were made, as shown in Table III. Table III does show lower, and less erratic, penetrations.

A. Snyder Suit

The suit would not hold any pressure. While the subject was standing still, the pressure sensor was zeroed at each flowrate. The bending exercises showed sudden pulses from zero to -3" of H_2O pressure. This may have been kinking of the probe line. But, bending always showed high penetrations, so rapid pressure pulse may have been aiding aerosol dispersion.

B. Mound Suit (EMS-1560)

The pressure inside the suit at chest level never went negative. The amount of positive pressure depended on the flowrate. The amount of positive pressure at a flowrate could be measurably lessened by the subject's normal inhalation even at supply flowrates as high as 8 cfm.

IV. Internal Suit Temperatures

Table IV gives the temperature results for the Snyder suit tests.

Table V gives the temperature results for the Mound suit tests.

V. Subject's Comments

A. Snyder Suit

1. Pants suspenders, good.
2. Shirt tie-downs, good.
3. Drawstrings at pants and shirt waistbands, not good; would not draw tight enough.
4. Air delivery system very annoying, air jet directed at right eye, causes severe headache after one hour.
5. Arms and legs receive virtually no cooling. Inside of suit, arms and legs covered with condensed sweat after one hour of testing.

B. Mound Suit (EMS-1560)

1. Pants and shirt elastic waistbands, good.
2. Shirt needs tie-downs.
3. Suit uncomfortably inflated even at low flowrates.
4. Air delivery system irritates eyes and ears. Suggest some kind of baffle to keep air jets out of eyes.
5. Arms and legs receive virtually no cooling. Inside of suit, arms and legs covered with condensed sweat at the end of one hour of testing.

VI. Suit Comparison

A. Aerosol Penetration

The Mound bubble suit, with pants suspenders, has lower and less erratic penetrations than the Snyder suit or the Mound bubble suit without pants suspenders.

B. Internal Pressure

The Mound bubble suit always maintained a positive internal pressure. The Snyder suit never showed a measurable positive internal pressure.

C. Internal Temperature

Both suits maintained a fairly constant chest region temperature. Neither suit provided effective cooling for the extremities.

VII. Recommendations

The Mound bubble suit with pants suspenders provides the better protection of the two suits tested. The Mound bubble suit had the better wearer response of the two suits tested. Internal temperature of the suits was comparable. Therefore, we recommend the use of the Mound bubble suit with suspenders to hold the pants waistband as high as possible.

Table I

PERCENT PENETRATION vs EXERCISE
AT VARIOUS FLOW RATES: SNYDER SUIT

Flow Rates (cfm)

Exercise	1	2	3	4	5	6	7	8	9	10
Standing	T	0.01	0.003	0.001	0.02	0.01	0.001	0.001	0.001	0.00
Bending		2.0	1.5	3.5	1.0	1.1	0.28	0.50	1.0	1.3
Running	T	T	1.5	1.6	4.8	1.0	1.5	0.2	0.55	0.01
Lifting arms	T	T	1.0	1.2	0.9	2.4	0.45	0.4	1.3	0.32
Twisting	T	T	0.5	6.0	0.22	1.9	0.12	0.3	0.17	0.02
Standing	T	T	0.008	0.001	0.02	0.013	0.001	0.002	0.001	0.00
Purge time from maximum leakage (Min)	T	>2	1.5	1.5	1.0	1.0	1.0	1.5	1.0	0.5

Table II

ENS-1560

PERCENT PENETRATION vs EXERCISE
AT VARIOUS FLOW RATES: MOUND SUIT - WITHOUT SUSPENDERS

Flow Rates (cfm)

Exercise	1	2	3	4	5	6	7	8	9	10
Standing	0.001	0.001	0.002	0.004	0.001	0.003	0.001	0.004	0.001	0.001
Bending	1.8	0.014	0.04	0.35	0.005	0.024	0.022	0.004	0.020	0.001
Running	1.6	0.017	0.011	8.0	0.004	0.84	-	0.014	0.001	0.001
Lifting arms	T	0.004	0.005	-	0.001	-	-	0.004	0.053	0.001
Twisting	T	0.002	0.004	-	0.002	-	-	0.005	0.001	0.001
Standing	T	0.002	0.003	0.005	0.001	0.003		0.004	0.001	0.001
Purge time from max leakage (Min)	3.5	1.5	3	4.5	-			1	2	-

Note: (-) indicates readings were indeterminable

TABLE III
ENS-1560

PERCENT PENETRATION vs EXERCISE
AT VARIOUS FLOW RATES: MOUND SUIT - WITH SUSPENDERS

Flow Rates (cfm)

Exercise	1	2	3	4	5	6	7	8	9	10
Standing	T	0.002	<0.001	0.001	0.002	0.002	0.001	0.001	0.002	<0.001
Bending	T	0.004	0.19	0.003	0.032	0.004	0.002	0.011	0.003	<0.001
Running	T	0.26	0.16	0.015	0.013	0.006	0.003	0.002	0.002	<0.001
Lifting arms				0.005	0.004	0.004				
Twisting				0.005	0.004	0.003				
Standing				0.002	0.002	0.003				
Purge time from max leakage (Min)				1	1	0.5				

TABLE IV

AVERAGE TEMPERATURES (°F) DURING EXERCISES AT VARIOUS FLOW RATES: SNYDER SUIT

Flow Rates (cfm)

Exercise	2			3			4			5			6		
	Arm	Leg	Chest	Arm	Leg	Chest	Arm	Leg	Chest	Arm	Leg	Chest	Arm	Leg	Ch
Standing	86	81	81	82	78	80	82	82	77	84	75	79	80	75	
Bending	88	82	82	82	78	81	82	80	80	85	77	79	80	77	
Running				83	79	82	78	75	80	85	76	80	80	76	
Lifting arms				82	80	82	79	76	79	84	75	79	80	74	
Twisting				85	78	81	80	76	79	85	75	78	80	75	
Standing				85	78	81	79	76	78	84	75	79	80	75	

Flow Rates (cfm)

Exercise	7			8			9			10		
	Arm	Leg	Chest	Arm	Leg	Chest	Arm	Leg	Chest	Arm	Leg	Chest
Standing	80	74	77	82	74	78	88	78	80	87	76	80
Bending	82	77	79	82	76	78	87	78	80	87	78	80
Running	83	74	79	81	76	78	90	79	80	88	79	80
Lifting arms	82	74	78	80	75	78	88	80	80	89	77	80
Twisting	81	74	78	82	76	78	85	77	80	89	78	80
Standing	82	74	76	82	77	79	85	77	80	88	77	79

TABLE V
(ENS-1560)

AVERAGE TEMPERATURES (^{0}F) DURING EXERCISES
AT VARIOUS FLOW RATES: MOUND SUIT

Flow Rates (cfm)

Exercise	2			3			4			5			6		
	Arm	Leg	Chest	Arm	Leg	Chest	Arm	Leg	Chest	Arm	Leg	Chest	Arm	Leg	Ches
Standing	88	83	82	89	86	82	83	86	80	78	80	78	83	84	80
Bending	87	83	83	89	86	83	83	84	80	79	81	79	83	84	81
Running	87	82	84	90	85	84	83	82	82	80	80	80	83	83	82
Lifting arms	86	84	83	89	87	83	82	84	81	80	82	80	82	84	81
Twisting	87	83	83	90	85	83	82	84	81	82	81	79	82	83	81
Standing	88	85	83	90	86	83	83	84	81	81	81	79	83	34	30

Flow Rates (cfm)

Exercise	7			8			9			10		
	Arm	Leg	Chest	Arm	Leg	Chest	Arm	Leg	Chest	Arm	Leg	Chest
Standing	88	83	82	84	84	80	88	83	80	82	80	78
Bending	88	83	82	83	83	80	88	83	81	84	81	79
Running	88	84	83	84	82	81	88	83	82	85	80	80
Lifting arms	[illegible]	84	82	83	84	81	88	84	81	86	84	79
Twisting	89	83	82	82	84	81	90	83	81	86	82	79
Standing	89	86	81	84	82	81	90	83	80	86	81	79