IAEA-TECDOC-295

DIRECTORY OF TRANSPORT PACKAGING TEST FACILITIES

A TECHNICAL DOCUMENT ISSUED BY THE
INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, 1983

DIRECTORY OF TRANSPORT PACKAGING TEST FACILITIES
IAEA, VIENNA, 1983
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FOREWORD

The International Atomic Energy Agency has published in Safety Series No. 6 the Regulations for the Safe Transport of Radioactive Materials which prescribed the tests (Section II and VII) to be made on packagings. Type A packagings shall be subjected to the tests to demonstrate the ability to withstand the normal conditions of transport and these are the water spray test, the free drop test, the compression test and the penetration test. The tests prescribed for demonstrating the ability to withstand accident conditions in transport, for which Type B packagings are further subjected include the mechanical test, the thermal test and the water immersion test.

Considering the increasing number of packages containing radioactive materials that are being shipped yearly, these packagings will have to be designed, fabricated, tested and re-tested to ensure their safe use in transport. Since not all Member States would be able to put up their own test facilities, the Agency, therefore, upon advice by the Standing Advisory Group on the Safe Transport of Radioactive Materials (SAGSTRAM), undertook to collect information on existing test facilities in Member States, see attached copy of circular letter, L/443-1, dated 6 April 1982. As a result of this enquiry, 31 Member States responded, of which 13 states indicated available test facilities and provided the necessary information.

The report lists the facilities and services existing in the reporting Member States which can be made available for use by other states by arrangement. The directory gives the technical information on the facilities, the services, the tests that can be done and in some cases even the financial arrangement is included. It is hoped that this report should be of use to competent authorities, designers, builders and carriers involved in the transport of radioactive materials.

The preparation and collation of this report was initiated by B. C. Bernardo (Philippines) then a staff member and finalized by D. M. Pal of the Division of Nuclear Safety.

INTERNATIONAL ATOMIC ENERGY AGENCY
AGENCE INTERNATIONALE DE L'ENERGIE ATOMIQUE
МЕЖДУНАРОДНОЕ АГЕНТСТВО ПО АТОМНОЙ ЭНЕРГИИ
ORGANISMO INTERNACIONAL DE ENERGIA ATOMICA

WAGRAMERSTRASSE 5, P.O. BOX 100, A-1400 VIENNA, AUSTRIA, TELEX: 1-12645, CABLE: INATOM VIENNA, TELEPHONE: 2360

IN REPLY PLEASE REFER TO
PRIERE DE RAPPELER LA REFERENCE.

L/443-1 Circ. 6 April 1982

Sir,

I have the honour to inform you that the Agency has been considering the ways in which it could help Member States to fulfil the requirements of their regulations based on the Agency's Regulations for the Safe Transport of Radioactive Materials, Safety Series No.6.

One such service might be to provide, on request, information and advice on the facilities that could be made available by Member States for performing the tests prescribed in Sections II and VII of the Regulations (1973 Revised Edition as Amended). At the last meeting of the Standing Advisory Group on the Safe Transport of Radioactive Materials it was agreed that the Agency should prepare a list of package test facilities in Member States.

I would appreciate it very much if you would inform the Secretariat whether there are facilities for performing such tests in your country and, if so, whether packagings constructed in other countries could be tested there. If such packagings could indeed be accepted for testing, it would be very helpful if the competent national authorities could also outline the precise nature of the tests that could be performed, the type of certification that would be issued on completion of the tests, the financial implications and the name and address of the person or office to who the relevant correspondence should be addressed. Any additional information or documentation such as drawings or brochures concerning the testing facilities would also be of value.

It would be very much appreciated if the information requested above could be sent to the Agency not later than 31 August 1982.

Accept, Sir, the assurances of my highest consideration.

Nelson F. Sievering Jr.
Acting Director General

AUSTRALIA

The following information is taken from the letter, dated 6 December 1982 (IA 158/82), of the Permanent Mission of Australia to the International Atomic Energy Agency.

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1. Facilities for carrying out tests prescribed in Sections II and VII of the Regulations exist at the Australian Atomic Energy Commission Research Establishment at Lucas Heights near Sydney; equipment and staff are assembled as required to satisfy a particular test programme.

2. It is usual practice for the Australian Competent Authority (Department of Transport) to witness tests and to issue an appropriate Approval Certificate. In the case of a package being designed and manufactured outside of Australia with tests being carried out in Australia, the type of certificate to be issued is unclear. Full certification would require evidence of all aspects of the design and manufacture being in accordance with the Regulations. We therefore consider it appropriate that the degree of certification required by a proponent should be negotiated as a part of an agreement to carry out tests.

3. In summary, the AAEC may be willing to carry out tests on packages designed and manufactured outside of Australia. A decision to proceed would however require equipment and staff to be available together with agreement on the type of Approval Certificate to be issued on satisfactory completion of a test programme.

4. Enquiries pertaining to AAEC test facilities should be addressed as follows:

The Chairman,
Australian Atomic Energy Commission,
Private Mail Bag,
P.O. Sutherland,
N.S.W. 2232
AUSTRALIA

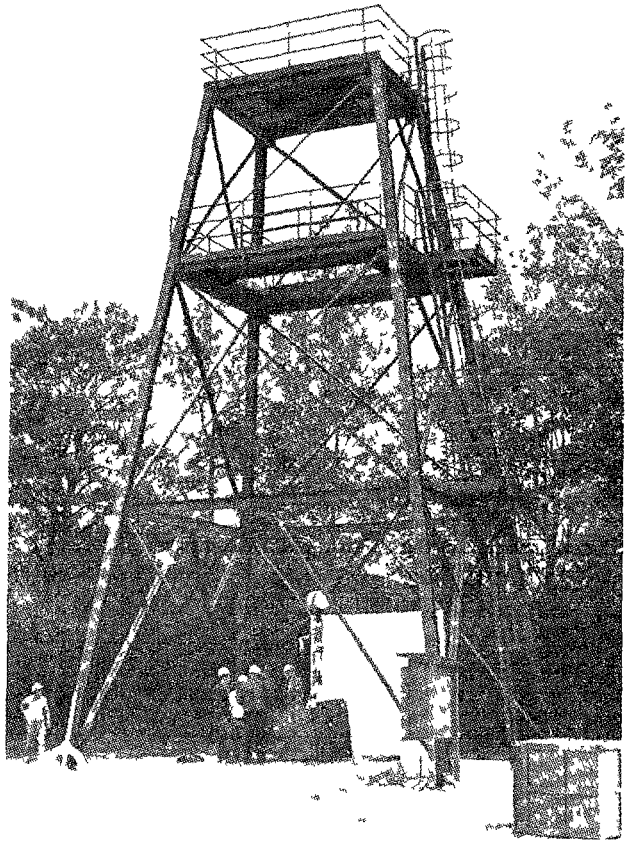
Att: Manager, Engineering Services
and Operations

CANADA

The following information is taken from the brochures provided by the Atomic Energy of Canada Limited in its letter of 14 July 1982.

ChalkRiver

PACKAGING TEST FACILITIES



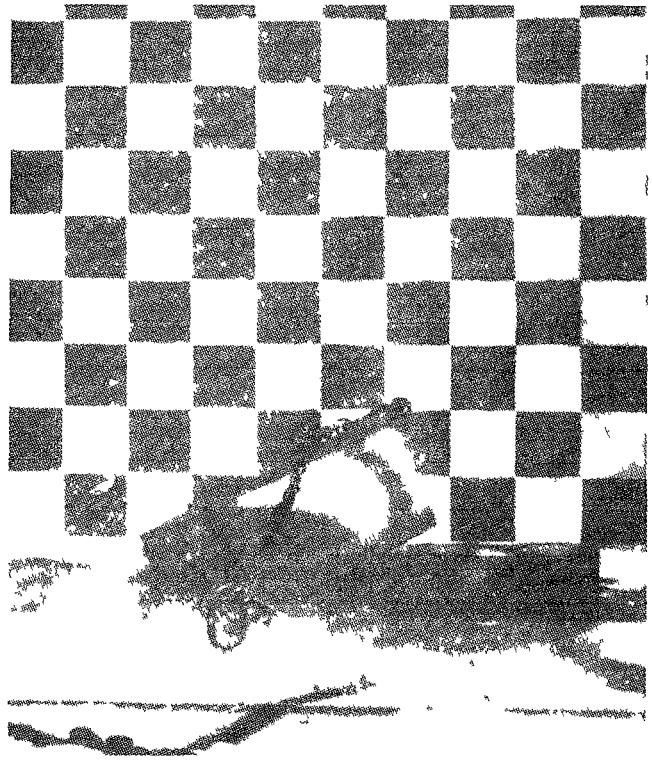
DROP TEST FACILITY

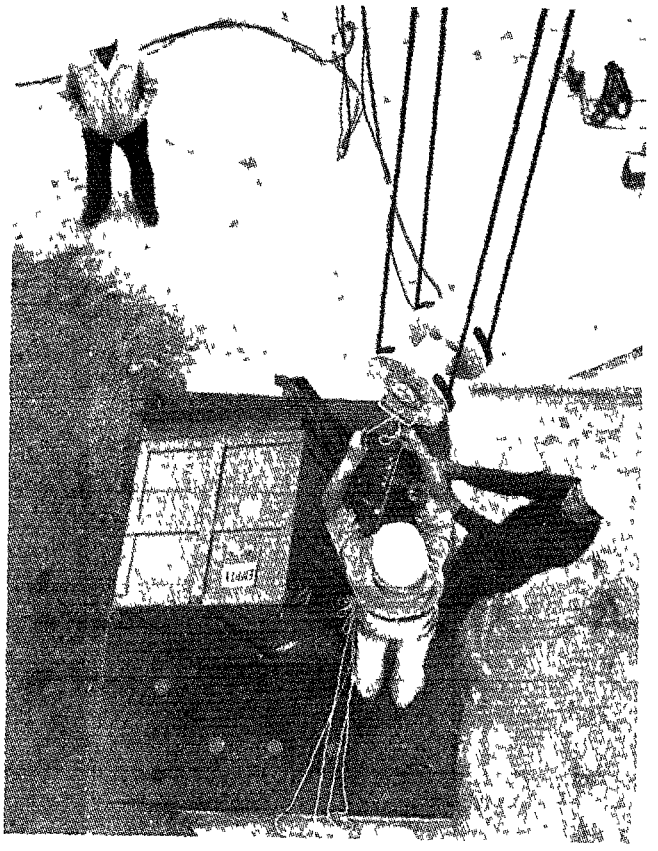
- Hoist Capacity - 9100 Kg
- Maximum package size - 2m x 2m x 2m
- Maximum drop height - 10m
- Photographic recording of impact on normal and high speed film
- Deceleration measurements by means of a piezoelectric type accelerometer

Due to its geographical location, Chalk River can carry out drop tests in a wide range of ambient temperatures (Approximately -30°C to 30°C)

Transportation of radioactive materials requires the use of packaging which can withstand severe shock and/or fire in the event of an accident

Chalk River has a drop test facility which is now being used by the Canadian nuclear industry, research establishments and utilities to carry out tests for submission to the Atomic Energy Control Board, Canada's nuclear regulatory body A fire test facility is under construction and should be available in the summer of 1983





FIRE TEST FACILITY

An open pit test facility is under construction and will be available by the summer of 1983.

- Maximum package size – 2m x 2m x 2m
- Maximum mass – 9100 Kg
- Package temperatures can be recorded during the thermal tests

SERVICES

- Packaging testing
- Photographic record
- Written report and deceleration analysis

These facilities are available to industry, utilities, research establishments and regulatory bodies in Canada and abroad.

CHALK RIVER:

- provides advisory and consultation services
- under contract carries out R&D work to meet the needs of individual companies
- undertakes development programs oriented to industrial needs

COMMERCIAL ARRANGEMENTS

Initial discussions are free and without obligation. All work is carried out in the strictest confidence.

Chalk River Nuclear Laboratories is the major research establishment of Atomic Energy of Canada Limited. It is located on the Ottawa River within easy driving distance of Ottawa, Ontario. In addition to our 450 professional engineers and scientists, Chalk River's total staff of 2300 includes a large contingent of technicians, technologists and trades people. We are therefore able to react quickly to solve a diverse range of technical problems.

We invite your further inquiry. Chalk River is pleased to offer its facilities, staff and R&D organizational experience to assist industry in solving its technical problems.

For more information please contact:

Commercial Operations Division
Chalk River Nuclear Laboratories
Atomic Energy of Canada Limited
Research Company
CHALK RIVER, Ontario
K0J 1P0

Telephone 613-584-3311
Telex 053-34555

FINLAND

The following information is taken from the letter (No. 2668) dated 12 October 1982, of the Permanent Mission of Finland to the IAEA

The Research Centre of Finland has performed thermal and free drop tests in accordance with Safety Series No. 6. Because these tests have been performed on a case-by-case basis no brochures as mentioned in the Agency's letter, are available.

The Institute of Radiation Protection has performed complete tests to one A-type packaging in accordance with Safety Series No. 6.

Because these two Institutes have performed tests on a adhoc basis only the possibility to use their facilities must be considered in each case separately.

FRANCE

The Representative of France on the Board of Governors of the IAEA provided the information in the following pages in its letter dated 6 September 1982 (274/82).

To date, the Ministry of Transport has approved eight testing centres (see enclosed list). These have the status of laboratories which have been certified for carrying out the regulation tests and such tests as might be requested by the chairman of the Interministerial Committee for the Transport of Dangerous Materials, as far as the packaging and containers for these materials are concerned.

Each centre is capable of carrying out a variety of tests covering a wide range and may be consulted by interested parties from France or abroad; however these centres are specialized in particular fields, and as far as packaging for the transport of radioactive materials is concerned, the institutions having most experience and the most suitable facilities are the following:

- The Commissariat à l'Energie Atomique - Centre d'Etudes Scientifiques et Techniques d'Aquitaine (CEA/CESTA), the facilities of which are located in the Bordeaux region.
- The Compagnie Générale des Matières Nucléaires (COGEMA) whose Special Transport Service (STS) has at its disposal the Moronvilliers Centre in the Reims region.
- The Laboratoire National d'Essais (National Testing Laboratory) (LNE) in Paris.

The first two of these institutions can perform tests on a wide variety of packages, including those of large size, whereas the LNE is better suited for tests on small packages and sources, whether or not of special form.

We are enclosing herewith documentation on these centres, specifying the nature and size of the facilities and the opportunities which are available.

The Tergnier Testing Centre (of the National Railways (SNCF)) specializes in tests on containers and tanks, and may be consulted with respect to this particular subject.

LABORATORIES CERTIFIED BY THE MINISTRY OF TRANSPORT
(for packaging of dangerous materials)

		Telephone
1	BUREAU des CONTENEURS (siège) (Container Dept., Headquarters)	
	44, rue de Rome - 75008 PARIS	(1) 285.98.45
	CENTRE d'ESSAIS (Testing Centre)	
	TERGNIER - Centre National d'Essais de Conteneurs - BP 103 - 02700 TERGNIER	(23) 56.02.87
2	CENTRE d'ETUDES SCIENTIFIQUES et TECHNIQUES d'AQUITAINE (CEA-CESTA) (Aquitaine Centre for Scientific and Technical Studies)	
	33830 - BELIN-BELIER - BP n° 2 - Le Barp	(56) 23.10.50
3	LABORATOIRE NATIONAL d'ESSAIS (LNE) - Siège (National Testing Laboratory, Headquarters)	
	1, rue Gaston Boissier - 75015 PARIS	(1) 532.29.89
	DEPARTEMENT Emballage et Conditionnement (Department of Packing and Packaging)	
	11 avenue Georges Politzer - 78190 TRAPPES	(3) 051.10.09
4	CENTRE d'ETUDES et de RECHERCHES des CHARBONNAGES de FRANCE (CERCHAR) (Study and Research Centre of the Coal Fields of France) (CERCHAR)	
	BP n° 2 - 60550 VERNEUIL en HALATTE	(44) 55.35.00
5	LABORATOIRE d'ETUDES et de RECHERCHES des EMBALLAGES METALLIQUES (LEREM) (Study and Research Laboratory for Metal Packaging) (LEREM)	
	3, rue Fernand Hainaut - 93400 SAINT OUEN	(1) 255.51.00
6	BUREAU de VERIFICATIONS TECHNIQUES (VERITEC) (Technical Testing Dept.) (VERITEC)	
	43 bis, avenue de la République - 94260 FRESNES	(1) 668.50.30
7	CENTRE d'ETUDES des MATIERES PLASTIQUES (CEMP) (Study Centre for Plastic Materials) (CEMP)	
	65, rue de Prony - 75017 PARIS	(1) 763.12.59
	LABORATOIRES (Laboratories)	
	11, avenue Georges Politzer - 78190 TRAPPES	(3) 051.10.09
8	COMPAGNIE Gale des MATIERES NUCLEAIRES (COGEMA STS)	
	2 rue Paul Dautier BP 4-78141 VELIZY-VILLACOUBLAY CEDEX	(3) 946.96.41
	CENTRE d'ESSAIS (Testing Centre)	
	51400 MORONVILLIERS	

I. C. E. A. - C. E. S. T. A.
B.P. No. 2 - LE BARP
33830. BELIN-BELIET

II. Compagnie Generale des Matieres Nucleaires (COGEMA)
2, rue Paul Dautier,
B.P. No. 4
78141. VELIZY-VILLACOUBLAY CEDEX

III. Laboratoire National d'Essais
1, rue Gaston Boissier
75015. PARIS

C.E.A./CESTA (FRANCE)

I - IDENTIFICATION AND GENERAL INFORMATION

Title and address of installation

C.E.A. - C.E.S.T.A.
B.P. No. 2 - Le Barp
33830 Belin-Beliet
France

Date of establishment: 1965

Operated by Governmental organization

General description of site and routes of access:

10 km^2 area in a plain; isolated, easily accessible site.

II - DESCRIPTION OF FACILITIES AND SERVICES

(a) General description

All facilities can be operated by remote control from an underground bunker in which all observations and measurements are performed. Dangerous items can be tested.

(b) Type A tests

Water spray test

Free drop tests

- Packages for solids;
- Packages for liquids and gases;
- Targets: 400 t concrete plus anchored steel plate

Compression test with masses handled by a tower 17 m high

Penetration measured by a free drop test on a special cylindrical (Ø 10 cm) target

Shielding integrity test

Containment integrity test.

(c) Type B tests

(c.1) Mechanical tests

- Drop tests from different towers:

  h = 28 m m = 2 000 kg
  h = 15 m m = 32 000 kg
  h = 15 m m = 3 000 kg

  Suspension by cable; attitude control mechanism (anti-rotation cables)

  Possibility of increasing the velocity of the specimen by adding rockets pushing it towards the target

  Drop system: Pyrotechnics

  Deceleration and deformation measurements

  Photographic recording of impacts (20 000 in/s)

  Scale model testing.

(c.2) Thermal tests

- Open fire: 2 m x 4 m capable of reaching 1100°C during 1½ h.
  Possibility of temperature and flux measurement

- Furnaces: h = 1.25 m
  d = 0.3 m
  temperature = 900°C, programmable.

(c.3) Water immersion test

Simulated depth conditions in pressurized ordinary or sea water (60 bar)

Pressure and deformation measurements

Integrity tests:

- shielding and containment tests.

(d) Special form material tests

- Impact tests with air compressed guns

  Maximum diameter: 300 mm
  Maximum pressure: 350 bar

  Velocity of the projectile: 250 m/s for a mass of 250 kg

  Heat test in various temperature chambers up to ($27\ m^3$ - 100°C) or ($3\ m^3$ - 150°C)

III - ADDITIONAL FACILITIES AND SERVICES

(a) Materials testing

Traction - compression machines

Fatigue testing

Chemical testing and analyses

Damping testing

(b) Low-temperature testing

In various chambers, down to $-60^{\circ}C$ ($27\ m^3$)

(c) Vibration testing

(c.1) Electrodynamic shakers up to 150 kN

(5-2000 Hz) Triaxial vibration facility

(c.2) Electrohydraulic shakers up to 250 kN

(0-300 Hz)

(d) Other types of testing

- Shock testings on 2 t specimen
- Acoustic testing 155 dB in $600\text{-}m^3$ chamber
- Centrifuge testing 2 t at 100 g

IV - INTERNATIONAL AVAILABILITY OF SERVICES

Prior to the test, visits and meetings can be organized at CESTA. When the problem is clearly specified, a technical and financial proposal is sent to the customer.

During the test, the customer's personnel may be present at the operations.

When the customer's personnel must be present at the Centre, CESTA must be advised in advance (name, surname, date and place of birth, personal address, passport number, nationality and company of the persons concerned).

When the test is over, a rough report (raw data) is sent to the customer. Later, a detailed report is submitted (generally with photos).

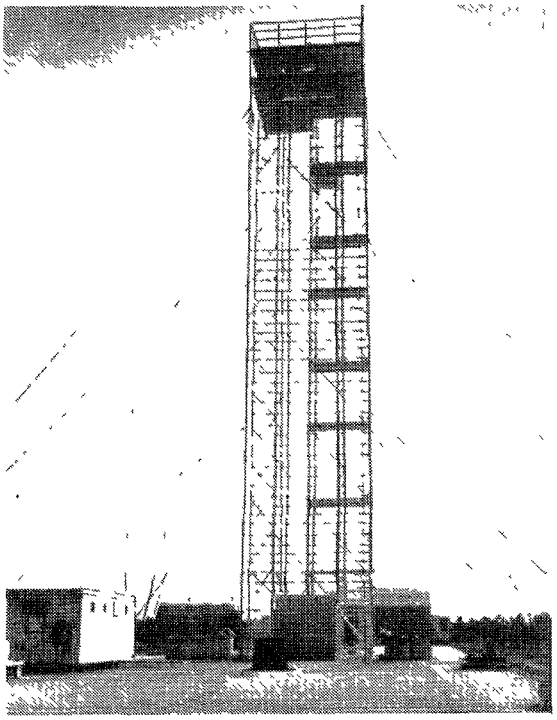
C.E.A. - D.A.M. - C.E.S.T.A.

Commissariat à l'Energie Atomique
Department of Military Applications
Aquitaine Centre for Scientific and Technical Studies

CATALOGUE OF ENVIRONMENTAL FACILITIES

Service Experimentation (Experimentation Dept.)

CESTA BP No. 2 33114 Le Barp Tel: 56 - 23 10 50



Builder: ENTREPOSE

Installation: C.E.S.T.A.
External testing terrain

Dimensional characteristics

Height: 31 m

Base dimensions: 5.9 m x 4.9 m

Structural framework: tubes 46 x 49

Stability ensured by three sheets of stays fixed at 20 m from the foot of the tower.

Technical characteristics

Area of fall (dimensions: 3 m x 2 m

Target (type: on request (concrete reaction block: M = 400 t)

Maximum length of fall: 28.8 m

Maximum load: 2000 kg

Safety devices: pulleys equipped with anti-rotational cables - End-of-run stops at the top and bottom

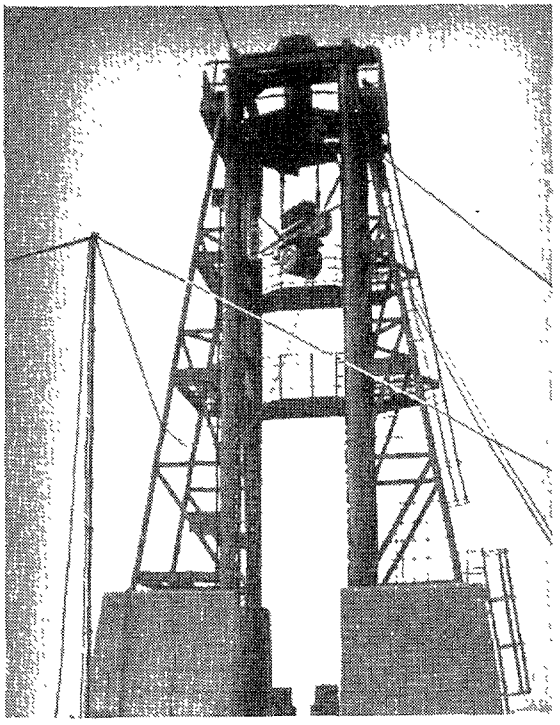
Remote control of fall: Yes

Functional characteristics

Hoisting system: two electric pulleys (1500 kg - 7 h.p.)

Release system: electric release catch or pyrotechnical means

Movement on the testing terrain: No



Builder: ERISOM

Installation: C.E.S.T.A.
External testing terrain

Particular feature:

Can be used for drop testing from a height of 9 m for transport packagings of radioactive materials in their true size ($M \leq 32\ 000$ kg)

Dimensional characteristics

Height:	17 m
Base dimensions:	7 m x 3 m
Structural framework:	tubular

Technical characteristics

Area of fall	(dimensions: 2.2 m x 6.0 m
- Target	(type: on request (reaction block: M = 400 t)
Maximum length of fall:	15 m
Maximum load:	32 000 kg
Safety services:	anti-rotational cable
Remote control of fall:	Yes

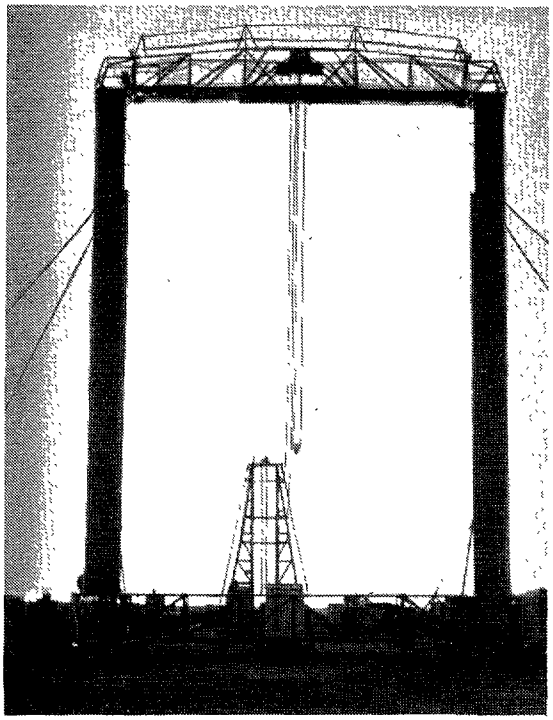
Functional characteristics:

Hoisting system:	electric windlass (normal voltage 11 cm/min)
Release system:	pneumatically controlled catch and pyrotechnical means

Movement on the testing terrain: No

See EXPERIMENTATION

DROP BRIDGE



BUILDER: ERISOM

INSTALLATION: C.E.S.T.A.

Outside testing ground

MEASUREMENT CHARACTERISTICS:

Length of cross beam: 14 m

Height: 18 m

Dimensions of base: 2 Ø of 1 m

Framework: tubular

TECHNICAL CHARACTERISTICS:

Drop area (Dimensions: Ø 10 m
(Type: as required

Maximum height of drop: 15 m below release catch

Maximum load: 3000 kg

Safety devices: anti-gyrating cable - unit is wedged by means of jacks - slinging

Remote controlled drop: yes

FUNCTIONAL CHARACTERISTICS:

Method of hoisting: electric winch (3000 kg)

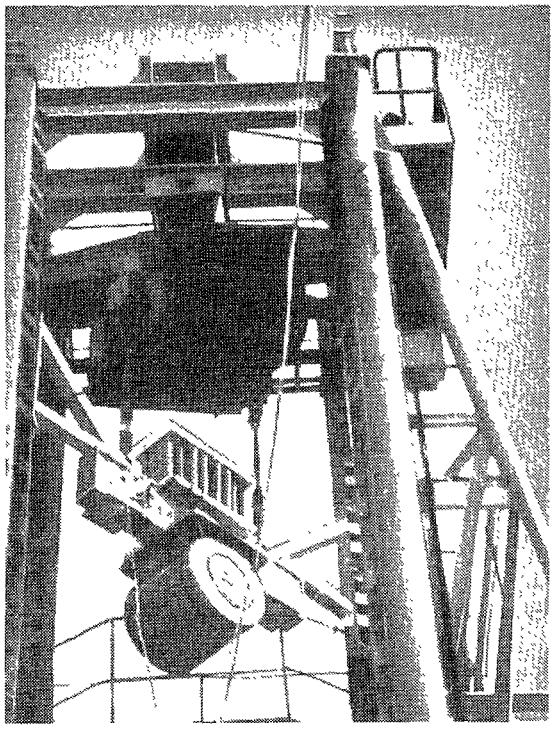
Method of release: electrical release catch or pyrotechnic device

Locomotion on testing ground: moves on low-pressure wheels along guide rails (150 m)

C.E.A./D.A.M. C.E.S.T.A.
Experimentation Dept.

IMPACT TESTING FACILITIES
DROP TOWERS AND FRAMES
RUN-UP BY MEANS OF
POWDER-DRIVEN IMPELLERS (ROCKETS)

Data Sheet
No. 2-304
15.09.78



Builder: C.E.S.T.A.

Installation: C.E.S.T.A.
External testing terrain, on towers and frames

Particular feature:

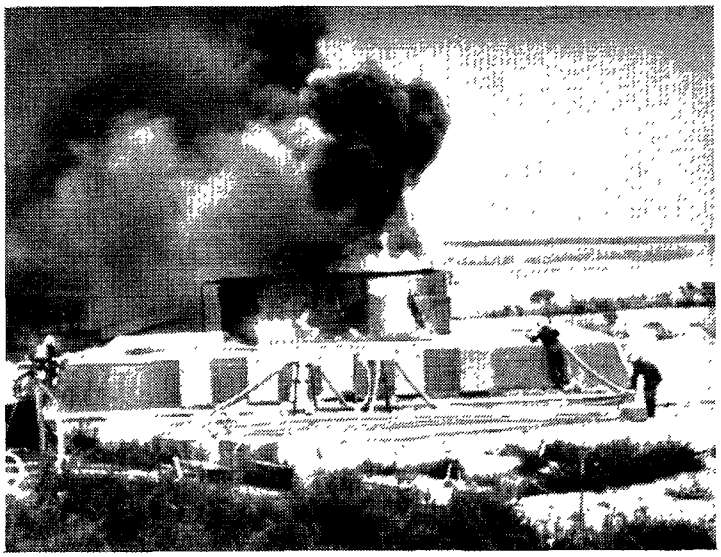
Can be used for impact testing in velocity ranges compatible with those coming under consideration in air transport.

Characteristics

- Run-up by means of small powder-driven rockets, from towers and frames ("thrust" method or "traction" method)
- Rockets: Thrust $\leq$ 1500 daN
  duration of thrust: $\leq$ 1.2 s
- Those most often used: T.B. diam. 68 (368 daN, during 800 ms)
- Run-up characteristics: dependent on the mass of the specimen and of the frame used. For example, from among the tests already carried out:
  - On the ERISOM tower: 1200 kg at 30 m/s (by means of nine rockets: T.B. diam. 68, thrust over 28.5 m)
  - On the ENTREPOSE tower: 150 kg at 80 m/s (by means of four rockets: T.B. diam. 68, thrust over 28.5 m)
- Measurements: wire system (mechanically reinforced connection cables), or by telemetry.

Other characteristics

- Those of the towers and frames used.



Builder: C.E.S.T.A.

Installation: C.E.S.T.A.
External testing terrain

Particular features:

Can be used for subjecting a specimen (possibly explosive) in the open air to the conditions of a fire induced by kerosene or some other fuel.

Dimensional characteristics:

Concrete pit containing tanks with a total surface area of 28 m^2.

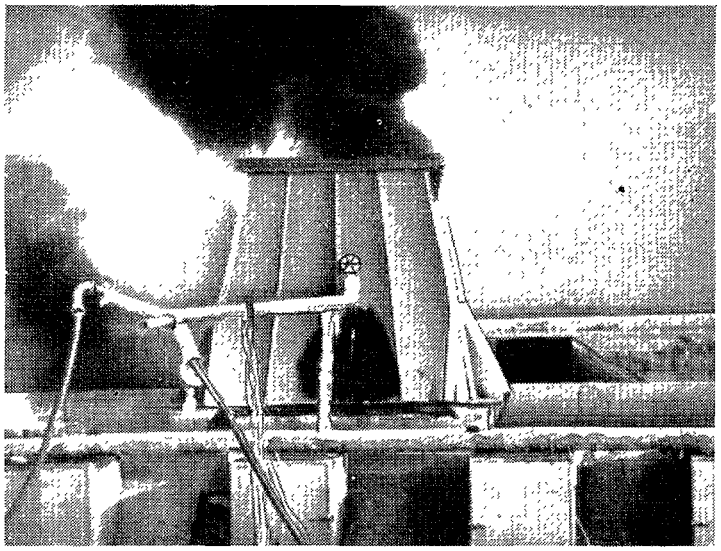
Technical characteristics:

Maximum temperature:	at the specimen positioned above the ignited kerosene: + 2000°C
Temperature recording:	By means of thermocouples; maximum of 100 channels; scan frequency: 10 per s to 1 per several min.
Remote control of:	filling of pit with kerosene
	igniting the kerosene
	extinguishing the fire with synthetic foam in 30 s
	purging the kerosene

Functional characteristics:

Feed:	By purging, from kerosene contained in storage tank
Ignition:	By igniters connected with an electric firing device
Purging:	By feeding nitrogen into pipelines under pressure

CLIMATIC TESTING FACILITIES
EQUIPMENT FOR FIRE AND FLAME TESTING
FIRE PIT
ADAPTATIONS (HOOD) FOR "PROLONGED, HIGH-TEMPERATURE" TESTING



Builder: C.E.S.T.A.
(PETIGNOT Company, Bordeaux)

Installation: C.E.S.T.A.
External experimentation terrain
Movable on the terrain

Particular features:

Installed in connection with a possible revision of the existing regulations governing the transport of packagings containing radioactive materials.
Can be used for subjecting a specimen to "prolonged, high-temperature" thermal testing.

Dimensional characteristics:

Height:	3.50 m (rests on four supports 0.60 m high)
Surface area of base:	2.50 m x 4.50 m (is placed over a 2 m x 4 m, i.e. 8 m^2, tank)
Surface area of upper part:	3 m x 1.5 m = 4.5 m^2

Technical characteristics:

- Metal hood lined on the inside with a (three layer) casing made of refractory panels. Has an outlet for the passage of a tube to accommodate the measurement channels.
- Metallic support, 1 m high (with protection against heat, to hold the specimen).

Functional characteristics:

Can be used for subjecting a specimen to heat testing defined by:
- Average ambient temperature 1100°C at the tested specimen;
- Length of exposure to fire: 1½ h at the most (possibility of extinguishing the fire in 30 s at any time during which it is going on).

Other characteristics:

See data sheet on preceding page.

COGEMA (FRANCE)

General information and descriptive material on testing facilities with particular emphasis on type A and type B tests, are included in the following paper JF/RP - STS No. 0275 of 29 April 1980.

The mechanical and thermal test procedures are also described.

IDENTIFICATION AND GENERAL INFORMATION

Title and address of installation: Station d'essais de (Testing station at) MORONVILLIERS.

Date of establishment: in operation since 1966 by the Compagnie Générale des Matières Nucléaires (COGEMA) 2, rue Paul Dautier - BP No. 4 - 78141 VELIZY-VILLACOUBLAY - Cédex.

DESCRIPTION OF FACILITIES AND SERVICES

General description

Type A tests

Water spray test

Free drop tests

- packages for solids
- packages for liquids and gases (9 m drop)
- suspension and attitude control arrangements
- targets

Compression test

Penetration test

Shielding integrity test

Containment integrity test

Type B tests

Mechanical tests

- drop I (9 m drop)
- drop II (in drop on punch)
- maximum weight capacities and maximum drop height capacity: 10 t x 10 m
- suspension mechanisms; attitude control mechanisms; release mechanisms
- targets for drop I and drop II

- deceleration and deformation measurements
- photographic recording of impacts
- scale model testing

Thermal tests

- open fire
- maximum weight and dimensional capacities for open fire: 60 t, 5 m x 5 m x 3 m
- temperature and flux measurements

Water immersion test

- actual immersion at appropriate depth
- simualted depth conditions, e.g. in pressurized water: diameter 2 m x length 3 m
- pressure measurements for simulated depth conditions
- maximum pressure capacity: 2 bar

Integrity tests

- shielding
- containment

Note: Taken from JF/RP STS No. 0275

I. INTRODUCTION

The Moronvilliers testing station was set up in 1966 by the Commissariat à l'Energie Atomique (CEA) so that it could carry out, on its own packaging for the transport of radioactive materials, the various tests specified by the "Recommendations for the Safe Transport of Radioactive Materials - 1964 Revision", published by the International Atomic Energy Agency (IAEA) and, since 1966, incorporated in various ministerial decrees relating to Class IVb of the Regulations of 15 April 1945 Governing the Transport of Dangerous Materials, the most recent one being that of 24 June 1974.

In 1976 it was transferred to COGEMA, a subsidiary of the CEA. It is administered by COGEMA's Special Transport Section.

In addition to those of the CEA and its subsidiaries, a large number of packagings of the EDF (Electricité de France) and of French and foreign private companies have already been tested there for certification purposes.

The present document, after giving a general description of the station, refers to the type of testing to which packages containing radioactive materials have to be subjected and then describes the facilities (including the measurement and control equipment) where these tests can be carried out. After a discussion of the testing methods and procedures and of manpower resources, it presents a summary of the station's activities.

II. LOCATION

The station is installed within a CEA centre located 30 km to the east of Reims, at a place known as Moronvilliers. The nearest populated centre is more than 9 km away.

Despite its distance from the Paris region, there are a number of advantages to this site, in particular the possibility of carrying out, without constraint or risk to the population, thermal tests by the so-called open fire method, which gives rise to abundant smoke, and also mechanical tests on packages containing radioactive materials (e.g. blocks of waste).

Thanks to this location, it can draw on the extensive facilities of the Centre (machine and metalwork shops, fire-fighting service, radiation protection service, equipment maintenance and staff accommodation facilities).

III. LAYOUT

The layout of the various facilities and buildings is shown in Fig. 1. The station covers an area of about 2500 m^2.

It includes:

- An area in which the facilities for mechanical and thermal testing are installed; these are separated by a storage area in which the tanks for the immersion tests are stored.

  A mobile frame, used for the mechanical tests, serves this area as a whole;

- An area containing small-scale structures accommodating an office, a small workshop and two stores. The workshop is equipped with the tools required for preparing the packaging, and especially for the mounting of accelerometers and thermocouples.

IV. TEST FACILITIES

4.1. Recapitulation of the main regulation tests

The Regulations (class IVb - Annex III) defines the following test sequences for the various types of packagings or packages:

- Industrial-type packaging

  1.20 m drop test

- Type A packaging

  Spray test
  1.20 m drop test
  Compression test
  Penetration test

- Type B(U) or B(M) packages

  Spray test
  1.20 m drop test
  Compression test
  Penetration test
  9.00 m drop test
  1.50 m drop test on vertical rod 150 mm in diameter
  Thermal test (fire)
  Test for immersion beneath 15 m of water

- Fissile material packages

  Spray test
  1.20 m drop test
  0.30 m drop test (eight drops)
  Compression test

Penetration test

9.00 m drop test

1.00 m drop test on vertical rod 150 mm in diameter

Heat test

Test for immersion beneath 0.90 m of water for 8 h

Test for immersion beneath 15 mm of water (if required).

A distinction is therefore made between mechanical tests, thermal tests and immersion tests, the purpose of which differs depending on the type of package to which they are applied.

We describe below the facilities with which the station is equipped in order to carry out these different kinds of tests.

4.2. Facilities for carrying out mechanical tests

4.2.1. Drop tests (9.00 m; 1.20 m; 0.30 m)

This facility, a longitudinal cross-section of which is given in Fig. 2, consists essentially in the following:

- A mobile frame with a release mechanism;
- A parallelepiped pit, the bottom of which is partly covered by a flat target and a target with a vertical rod;
- A shielded chamber housing the various items of apparatus of an accelerometric measurement system, where the impacts can be filmed;
- A workshop for the preparation of packagings;
- Service facilities (office, sanitary etc.).

This arrangement has made it possible to reduce the height of the frame and, taking into account the nature of the ground, to provide better stability for the targets. It also affords a means for providing satisfactory protection of personnel against debris which is thrown up.

Mobile frame and release device

The mobile frame (Fig. 2) has been specially designed to permit the release of a 10-t load; its runway is 56.00 mm long. Its hook could be equipped with release devices for maximum loads of 1 t and 10 t respectively. These are mechanical systems with semi-hooks, the opening of which is remotely controlled by means of a cable acting on a lever.

Pit

The pit (Fig. 4), the walls and base of which are of reinforced concrete, has the following dimensions:

- Length: 11.00 m
- Width: 4.00 m
- Depth: 3.30 m.

It can be covered by means of a sliding roof of the MacGregor type; thus, except during the very short period in which the test is going on, the staff can be sheltered from inclement weather. Access to the pit is by means of a stairway.

Targets

The target for the 9.00-m drop consists of the following, starting from the upper level:

- A 4.00-m x 3.00-m steel plate 0.10 m thick, anchored to a concrete block by means of tie-rods 33 mm in diameter and 0.50 m long;
- A 5.70-m x 3.70-m concrete block 2.25 m thick.

The aggregate is not linked to the walls of the pit and rests on the bare ground, consisting of a calcareous rock, with a layer of compacted sand 0.20 m thick in between. Thus the target has a mass of 150 t or 15 times the mass of 10 t of packaging, the heaviest that could be tested. Thus far the behaviour of this target has proved very satisfactory.

The target for the 1.00-m fall on a rod consists of a semi-hard steel bar 1.50 mm in diameter and 0.50 m high; the flat upper part is rounded off to a radius of 6 mm at the junction with the cylindrical part. This rod is welded to a steel plate measuring 1.00 m sideways and 0.10 m thick, which is anchored to a concrete block by means of tie-rods 30 mm in diameter and 0.50 m long.

The dimensions of the block are as follows: 2.00 m sideways and 1.25 m thick. The mass of this target is 20 t.

It will be noted that when the tests are carried out on scale-model packagings, the diameter of the rod must be reduced in accordance with the scale of the model; the station is therefore equipped with movable rods having different reduction scales and mounted on a movable base.

Guide devices for scale models

In the 9.00-m fall the problem of conserving the angle of initial fall hardly arises in the case of packagings of appreciable mass. On the other hand, mainly due to the wind or to the slight torque imparted at the moment of release, packagings of small mass, and especially models weighing a few dozen kg do exhibit this problem.

In the latter case, it is advisable to make use of a guide device. Figure 3 shows the principle of the device with which this station is equipped.

The guide-holder (4) slides along two parallel steel cables which are stretched vertically between the hook of the frame (1) and a casing (11) fixed on the 100-mm-thick metal plate which constitutes the target (12). The tension of the cables is obtained by means of a system of counterweights. A metal shaft (7) fixed rigidly on the model (9) determines the angle of fall; it passes through the guide-holder via a tube (8) in which it can move longitudinally practically without friction. At its upper end it has a ring which can pass into the tube and permits the aggregate consisting of the guide-holder and the model to be lifted to the desired height by means of an auxiliary electric pulley (5) equipped with a small release device (6). The model and the guide-holder can then be released simultaneously.

When the fall takes place the guide-holder is stopped shortly before the impact by means of two lugs (10) fixed on the casing. The guide shaft then slides inside the tube, becomes detached from the frame and the model continues its course in a free fall over a distance of approximately 0.50 m. Hence there is no risk of deforming the frame and the rebound phenomena are not obscured.

So far this device has given satisfactory results; it will be noted, in particular, that the measurements of time and velocity of fall which have been made do not show appreciably lower values than the theoretical values and that the initial angles are satisfactorily conserved.

4.2.2. Compression test

No special equipment is provided for carrying out this test, which is always performed by using a stack of model packagings, or by using various ballasts to ensure satisfactory distribution of the load.

4.2.3. Penetration test

The station is equipped with a 6-kg rod with an hemispherical end 3.2 cm in diameter, as defined by the Regulations (Annex III.2.4.a).

4.3. Facilities for carrying out thermal testing

The Regulations now in force (decree of 24 June 1974), unlike those which preceded it, no longer provide practical directions concerning the performance of the test, which can therefore be carried out, for example, either by means of a furnace or by using a hydrocarbon fire in the open air.

It is the second solution which was chosen for this test since it has the advantage of reproducing conditions very similar to those which would result from a fire during transport but nevertheless still complies with the theoretical conditions laid down by the Regulations concerning temperature, which must be higher than 800°C. Futhermore, the required installation is relatively simple and the maintenance costs low; the risk of deterioration in the event of an explosion is very limited; and lastly, the dimensions of the packaging or of the sections of packaging subjected to the test may be large.

Figure 4 gives the general characteristics of the facility, which include:

- A pit with its ventilation ducts and control devices;
- A fuel tank;
- A system for extinguishing by means of rapid emptying of the tank into a sump adjacent to the pit.

Pit

Tests carried out in 1963 with a fuel tank placed successively at ground level and then in a pit had shown that this second solution was by far the best from the point of view of control and stability of the fire as well as safety of the personnel. It is therefore this solution that was adopted.

The pit has a square cross-section of 5.05 m on each side. It has vertical walls and is 2.07 m deep. The bottom is flat, and has openings which are

connected with a sump which collects the unburnt fuel. The walls are protected by movable, vertical blocks of refractory concrete, which can undergo a maximum temperature of 1300°C without damage. A wind-cutter, consisting of an assembly of steel-sheet panels 1.00 m high, surmounts the upper part of the pit.

The air fed to the fire is obtained via four trenches, 1.00 m wide, and 9.00 m long. The base of the trenches slopes gently. The flow of air is regulated by means of movable flaps.

Fuel tank

The pit can accommodate several types of steel fuel tanks 10 mm thick. The choice of dimensions depends on the size of the packaging which is being tested.

The fuel is domestic fuel, to which a little petrol is added to facilitate ignition.

The packaging is placed 1.00 m from the bottom of the tank on a suitable metal support which does not form a screen between the flame and the walls of the packaging. Handling is effected by means of the movable frame which has already been described.

Two buried tanks, having a total capacity of 20 m^3 are used for supplying the pit with fuel.

Extinguishing device

In order to comply as accurately as possible with the regulation duration of the fire, it is important that the extinguishing should take place very rapidly and not result in artificial cooling of the packaging. To this end use is made of an instantaneous-opening valve, operated by remote manual control involving the use of a steel cable. This enables the tank to be emptied into the sump very rapidly.

The experience gained as a result of numerous tests shows that in these conditions the fire can be extinguished in less than one minute. It is therefore possible to comply exactly with the regulation duration of the test, i.e. 30 minutes.

4.4. Facilities for the performance of immersion and water penetration tests

The two types of regulation tests provided for are as follows:

- Immersion test in 15.00 m of water for at least 8 h;
- Test for the water penetration under 0.90 m of water for a period of at least 8 h (packages of fissile material only).

To carry out these tests the station is equipped with a vertical cylindrical tank with a lid fixed on by means of screws. This tank is 2.00 m in diameter and has an effective height of 3.00 m; once filled with water, it can be placed under pressure of 2 bar, which is higher than the 1.5 bar of the first test.

V. MEASUREMENT AND CONTROL APPARATUS

5.1. Measurements

Mechanical testing facilities

In addition to conventional small-scale metrological equipment which is used for accurate determination of deformations, the mechanical testing facility is equipped with an acceleration measurement system which is installed in an underground room adjacent to the pit.

This system can be used for the simultaneous recording and visualization of signals supplied by ten accelerometers.

It consists of the following:

- Ten ENDEVCO load amplifiers - type 2718;
- A recorder for signals on AMPEX magnetic tape, type CP 100. This apparatus has a capacity of 14 recording tracks for reading. The passband used is 20 kHz.
- A CEC galvanometric recorder. This device can be used for the simultaneous transcription on photosensitive paper of signals recorded on magnetic tape.
- A TEKTRONIC oscilloscope, type 524 B. This device, in conjunction with a Polaroid-type photographic apparatus can be used to visualize the signals recorded on magnetic tape.

The ENDEVCO Type 225 accelerometers used are piezoelectric detectors whose sensitivity is between 0.1 and 1 pC/g.

The measurement system can be used for recording accelerations ranging from a few g to 25 000 g.

Lastly, it is possible to film the impacts: for this purpose a port is provided at the target. If necessary, the camera used has a velocity of 3000 images per second.

Thermal testing facilities

Four MECI devices and an INDELCO apparatus (L 112 4S) installed in the local "office" and connected with the thermal testing pit by means of

underground cables are used for the continuous recording of temperatures while the tests are going on.

The MECI devices each have eight measurement channels and the ENDELCO apparatus 24 channels. Hence, a total of 56 measurement channels are available.

A container with cold welds is placed outside the pit. It constitutes the "cold source" from which the temperature, measured continuously by a thermocouple, is transmitted to the recorders which automatically ensure compensation.

The type of thermoelectric probe depends on the temperature value. Below 300°C the probes used are a combination of iron and constantan or copper and constantan, and above that temperature the probes used are a combination of chromel and alumel, with a sheath of stainless steel 2 mm in diameter.

Also available for internal temperature measurements, especially at points where it is difficult to place probes, are temperature indicators of various makes in the form of an adhesive strip which is applied to the surface of the part whose temperature is to be measured. Each strip has a number of measurment points consisting of a white patch which turns black once the reference temperature has been reached. The range of temperature normally used is from 37°C to 300°C.

The facility is equipped with an anemometer, since wind velocity has a decisive effect on the way the thermal test turns out: beyond 8 to 10 m/s it becomes difficult to carry out thermal testing in a satisfactory manner.

5.2. Controls

Leak-tightness

For carrying out leak-tightness checks the station has:

- A compressed air network;
- Immersion tanks;
- Special manometers;
- A freon leak detector.

Release of radioactive materials

For measuring the release of activity as a result of the tests, the station makes use, in certain cases, of a leaching tank 1.78 m high and 1.80 m in diameter. This tank is insulated and equipped with a sump pump and a system for regulation of water temperature.

VI. OPERATION

The station is managed and operated by the Special Transport Section of COGEMA.

Personnel

Since the tests are generally carried out in one- or two-week runs at the rate of eight to ten per year, the station has no permanent staff.

The team responsible for carrying out the tests is under the direction of an engineer from the technical group of the above-mentioned Section; it includes, in addition to this engineer, two higher-level technicians and, depending on requirements, specialists, engineers or technicians responsible in particular for acceleration and thermometric measurements etc. It also has the benefit of technical support from the various workshops at the Centre (metalworking, mechanical work, electricity).

VII. PERFORMANCE OF THE TESTS

The tests for each type of packaging are carried out in accordance with a programme which defines the type of tests, the test procedures (number of prototypes or small-scale models to be subjected to the tests; angles of fall; measurement points: accelerometric, thermometric etc.); the controls to be carried out before and after the tests. In general, the programme is determined by the customer in conjunction with the team responsible for carrying it out.

At present, where packagings from the CEA or one of its subsidiaries are involved, this programme must, prior to the performance of the tests, receive the approval of the Chairman of the Transport Safety Committee of the CEA, a representative of which is then present at the tests.

Once the tests are completed, a special record showing the results is prepared.

The mechanical tests are carried out either on 1:1-scale models of the packagings or, where this is impossible for reasons of price or incompatibility with the station's capabilities, on models reduced to various scales. The small scales (1:8, 1:10 or smaller) are often used in the packaging design stage to study its general behaviour: the larger scales - i.e. 1:3, 1:4 - are used for tests to certify the conformity of the packaging with regulations, particularly as regards conservation of leak-tightness.

The thermal tests are carried out either on 1:1-scale specimens of packaging or, as is at present the case for very bulky and very heavy packaging (several dozen tonnes), on 1:1-scale sections of such packaging. For

example, towards mid-1978 a thermal test was carried out on a section of a 100-t package designed for the transport of irradiated fuel from light-water nuclear power stations. This section, which was 2.50 m in diameter and 2.00 m long, had a mass of 40 t. Resistances placed in the central part of the package emitted, during and after the 30-min thermal test, a thermal power equivalent to that of the elements transported over the length under consideration.

The test required exceptional handling facilities, which were provided by the CEA Centre.

VIII. CONCLUSION

The COGEMA test station at Moronvilliers is fully equipped to carry out, under optimum conditions, all the regulation tests which have to be performed on packaging containing radioactive materials.

It is operated by highly qualified personnel having complete understanding of the problems involved in the study of packaging and its uses. Depending on requirements, this team can be supplemented by certified specialists from a wide variety of disciplines.

The station, which has been in operation since 1966, has been responsible for the performance of something like 500 mechanical tests relating either to packaging or parts of packaging or to the constitutent materials of packaging, and for approximately 100 thermal tests. In this way it has made a considerable contribution to improving the safety of packaging containing radioactive materials.

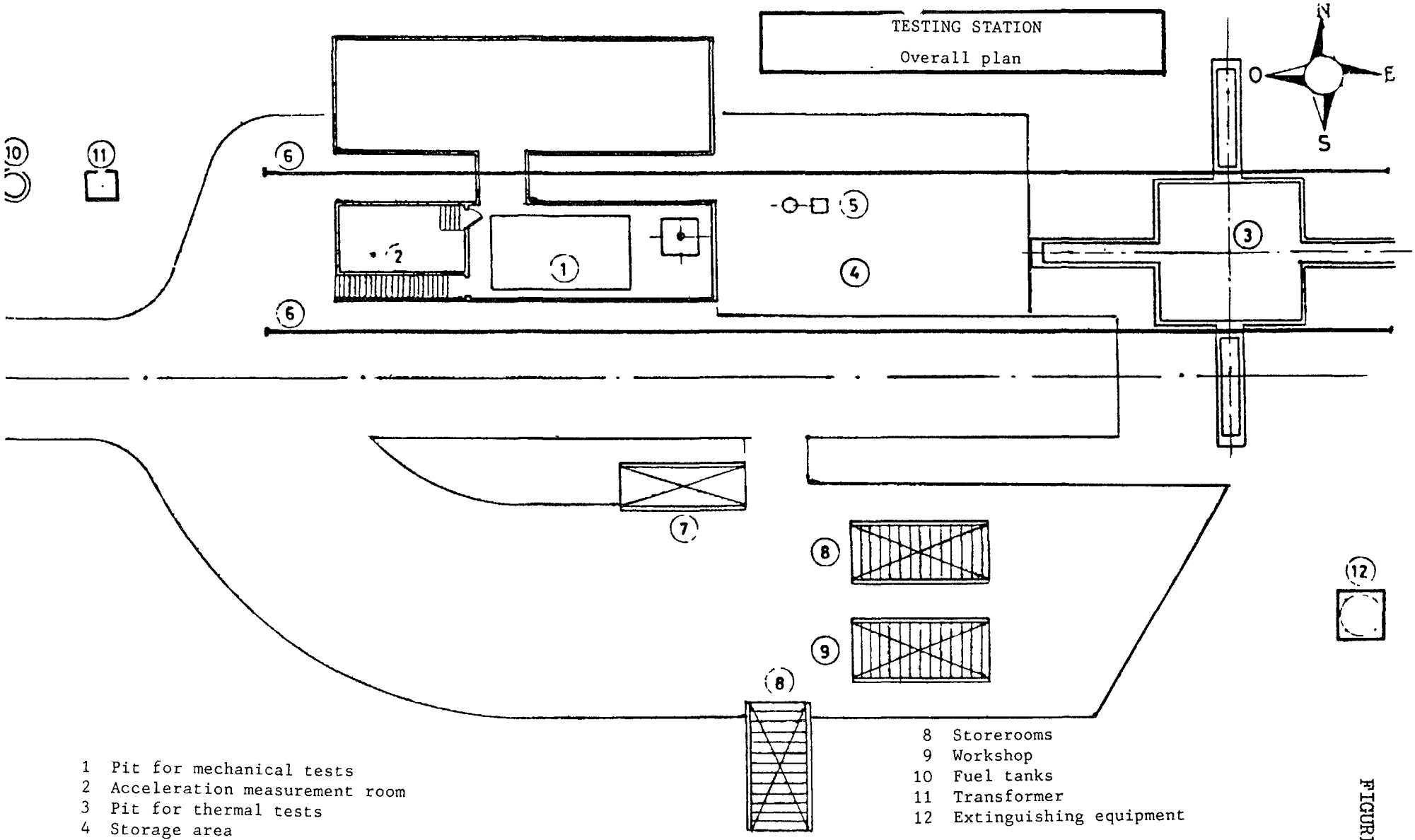

TESTING STATION
Overall plan
N
O
E
S
1 Pit for mechanical tests
2 Acceleration measurement room
3 Pit for thermal tests
4 Storage area
5 Material for leak-tightness checks
6 Frame runway
7 Office and thermal measurement room
8 Storerooms
9 Workshop
10 Fuel tanks
11 Transformer
12 Extinguishing equipment

FIGURE 1

TESTING STATION

Mechanical testing facility

1 Movable frame
2 Pit for mechanical tests
3 Fall target (I)
4 Concrete block
5 Sand bed
6 Concrete block
7 Acceleration measurement room
8 Port for filming
9 Fall target (II)

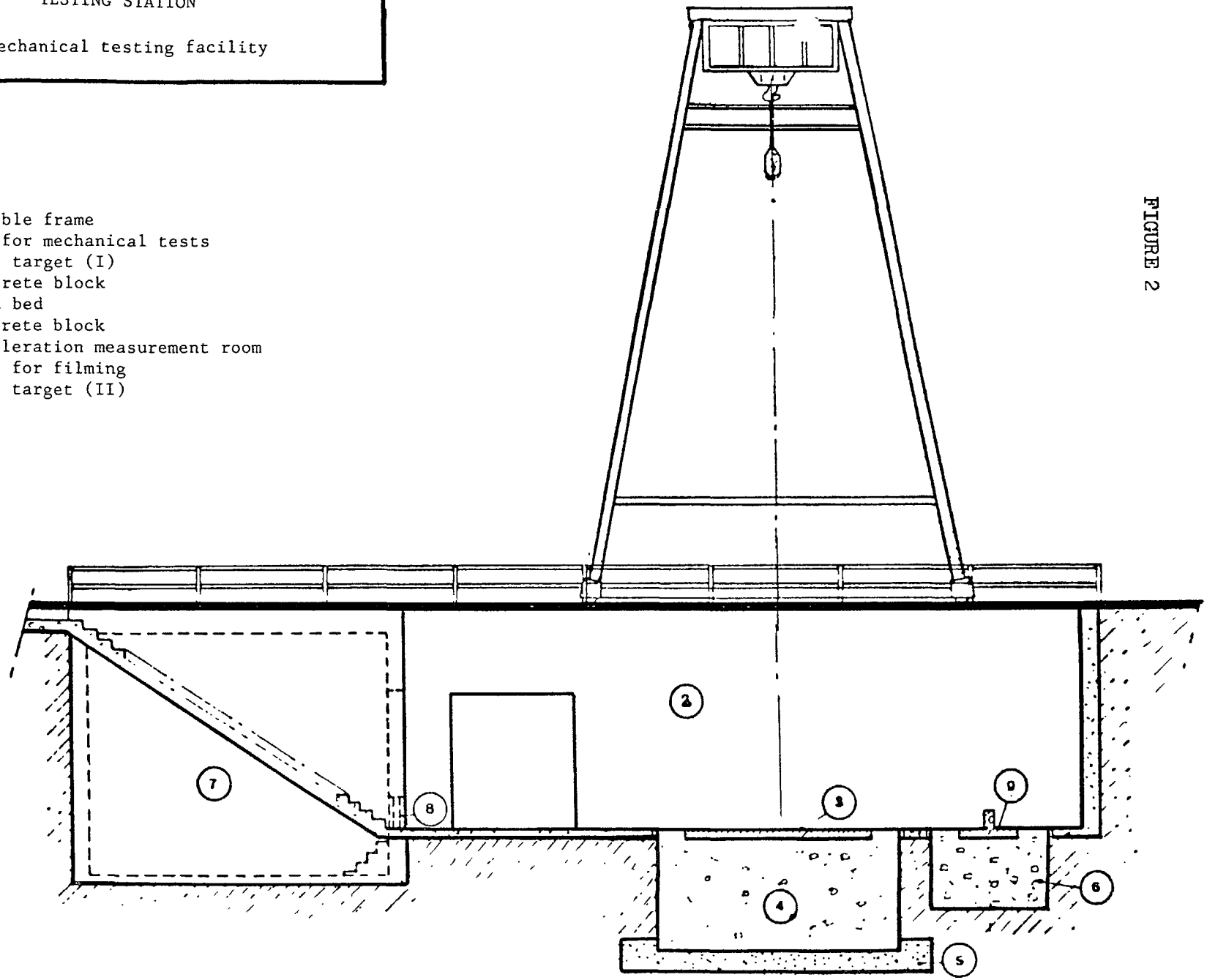
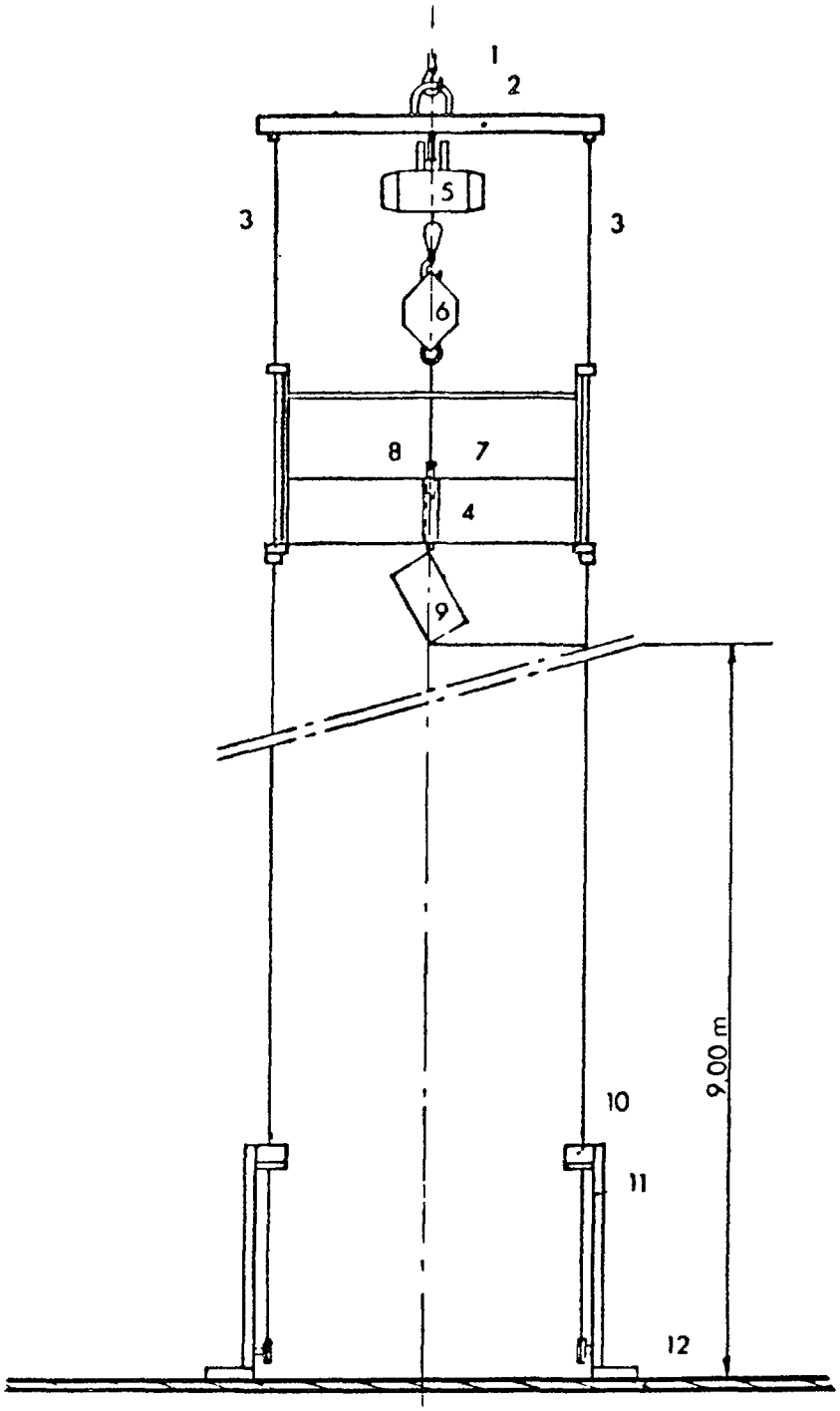


FIGURE 2

TESTING STATION

Guide device for scale models

FIGURE 3



1 Frame hook
2 Swing-bar support for guide cables
3 Guide cable
4 Guide-holder
5 Auxiliary pulley
6 Release device
7 Guide shaft
8 Guide tube
9 Scale model
10 Stopping lug for guide-holder
11 Casing fixed to the target
12 Target

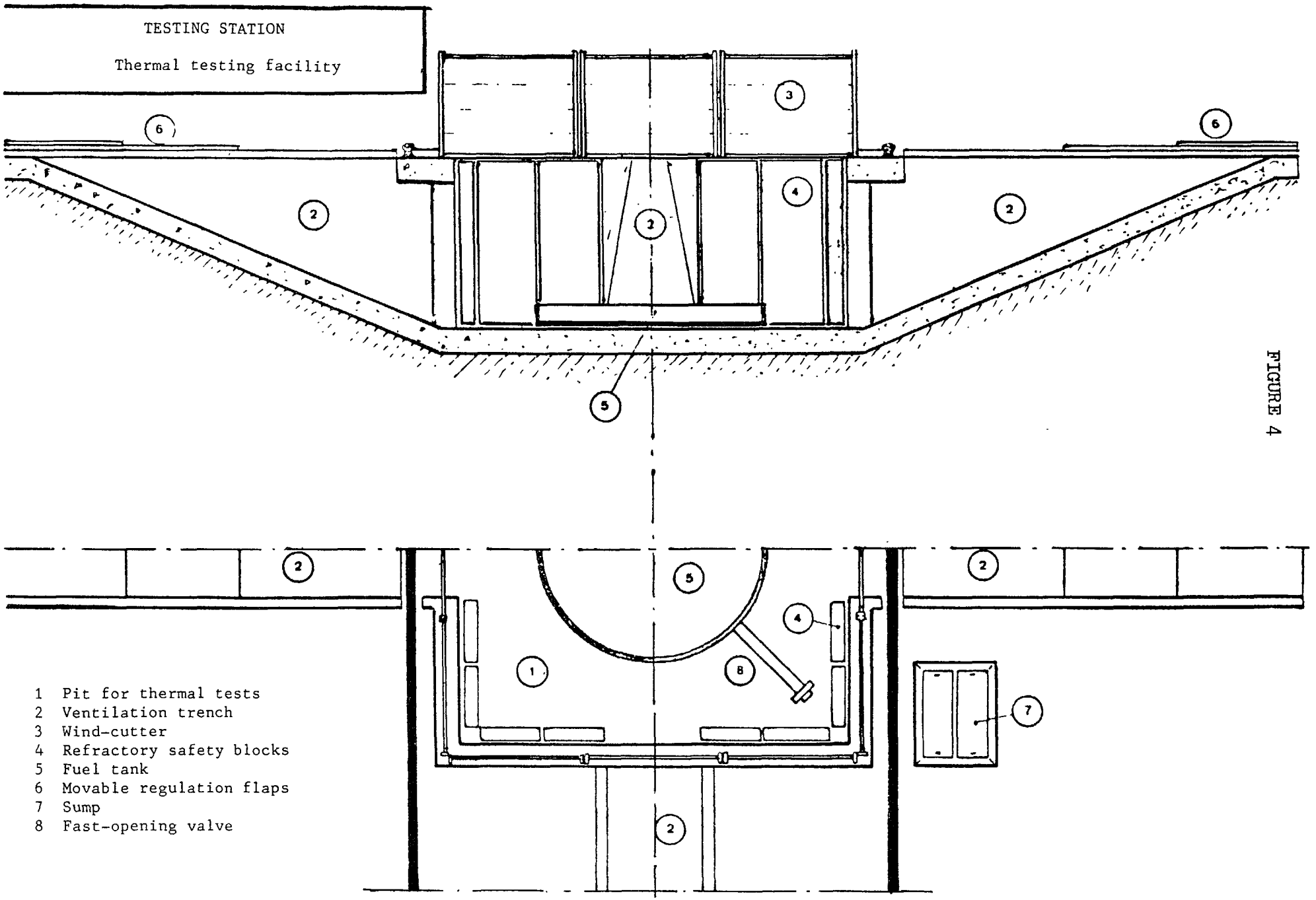

TESTING STATION
Thermal testing facility
1 Pit for thermal tests
2 Ventilation trench
3 Wind-cutter
4 Refractory safety blocks
5 Fuel tank
6 Movable regulation flaps
7 Sump
8 Fast-opening valve

FIGURE 4

III

LABORATOIRE NATIONAL D'ESSAIS (LNE)
(National Testing Laboratory)
France

I. IDENTIFICATION AND GENERAL INFORMATION

Title and address of the facility:

"Groupe Rayonnements Ionisants (Ionizing Radiation Group)
Laboratoire National d'Essais
1, rue Gaston Boissier
75015 PARIS

Telephone: 532-29-89 Telex: LNE 202.319F"

Date of approval:

Approved by the Ministry of Transport since 1977.

Administrative body:

The LNE is a public body of the industrial and commercial type.

Its supervisory authority:

Quality and Industrial Safety Division, Ministry of Industry (101, rue de Grenelle - 75007 Paris)

Number and category of staff employed:

The LNE has a staff of 400:

- The Ionizing Radiation Group includes one engineer and four technicians engaged in services connected with health, work safety and transport in ionizing radiation and in applied studies in nuclear physics.

Description of premises and means of access:

The LNE is located at Paris in a large building where 200 persons are employed. Facilities for heavy equipment are concentrated in a bay which is serviced by a 5 kdaN travelling crane (5 t). Other systems for heavy equipment are housed in a number of annexes having comparable maintenance facilities.

II. DESCRIPTION OF SYSTEMS AND POSSIBILITIES

(a) General description

The Ionizing Radiation Group has 300 m^2 of laboratories in which the facilities for the control of the following are housed:

- Sealed and unsealed sources;

- Packagings of a small and intermediate size;
- All apparatus making use of ionizing radiation.

The main control facilities are as follows:

- Four specially equipped glove boxes;
- A liquid scintillation spectrometry device;
- Various types of dosimeters, all calibrated;
- A helium mass spectrograph for leak detection.

For all tests which have to be carried out in workshops and not in the laboratory, the Group can draw on the services of any of the following departments of the LNE:

- Calibration and instrumentation;
- Equipment and structures;
- Machinery and vibrations;
- Process heat;
- Packaging and conditioning.

(b) Type A tests

Spraying with water:

Normal installation for packages up to 0.5 m^3.

Possibility of special, additional operations, without limitation on volume.

Free drop tests:

- Installation for 1-m drops up to 5 t.
- Installation for 9-m drops, up to 500 kg.
- Means for controlling suspension:
  - Hook for mechanical or electromechanical release;
  - Free drop without control of direction during fall;
  - Target: a concrete block (4 x 4 x 0.5 m) covered by a steel sheet (4 x 4 x 0.05 m) resting on 0.5 m of sand.

    Travelling crane, 9 m high without hook (maximum load 5 t);
  - Compression and penetration tests: no load limitation;
  - Shielding integrity testing: dosimetry with containers having a reduced radioactive load;

- Containment tests: control of leak-tightness by means of a radioactive tracer or bubbling, up to 2 lt for the containment system. Use of gas tracer for larger volumes;
- Possibility of checking on falls by ultra-fast camera.

(c) Type B tests

Mechanical tests:

9-m fall: up to a load of 500 kg at LNE (possibility of subcontracting in the case of larger loads).

1-m drop on punch: up to a load of 5 t at LNE.

- Suspension mechanism: choice of impact zone by a suitable suspension of the packaging.
- Release mechanism: mechanical or electromechanical hook.
- Fall-guiding mechanism: no such mechanism available at present.
- Targets: a concrete block (4 x 4 x 0.5 m) covered by 5 cm of steel, resting on 0.5 m of sand.
- Measurement of deceleration and deformation: where requested, it is possible to attach accelerometers and strain gauges at all sensitive points when recording at high speeds.
- Possible photographic recording of impact by means of an ultra-fast camera.
- Tests on scale models.

The behaviour of large packagings can be estimated by the use of small-scale models. The measurement of accelerations and strains on the models subjected to testing could be used to calculate the corresponding values for large packagings.

Thermal testing

The LNE does not have an installation for open flame testing but it can subcontract for such tests.

- The furnaces which can generally be used are adapted to packagings of a maximum of 0.3 m^3 in the temperature conditions specified in the transport regulations.

The LNE has all the necessary means for measuring temperatures in the packaging (from 3 to 12 measurement points).

Water immersion tests

- The tests are carried out in pressurized water, with a range of pressures and volumes adapted to standard forms of packaging (maximum pressure: 2000 bar).

Integrity and containment controls

The same conditions as for type A packaging. All the non-destructive control systems may be used for supplementary analyses.

(d) Tests of special form materials

The LNE is authorized by the Ministry of Transport and Environment to issue statements of compliance with the "special form" of all types of sealed sources. It also carries out tests for compliance with the ISO DIS 2919 and NFM. 61.002 standards.

The equipment required for carrying out these tests is described in an article of the:

Bulletin d'Information de L'ATEN (ATEN Information Bulletin), Supplement No. 93, January 1972: "Safety in the use of sealed radioactive sources" by J. Chatelet (in French).

III. ADDITIONAL SYSTEMS AND POSSIBILITIES

All types of environmental testing can be carried out at the LNE, either by the Ionizing Radiation Group or by one of the following departments:

- Very High and Very Low Temperatures
- Artificial Ageing
- Corrosion
- Vibrations and Impacts (very wide testing range)

IV. AVAILABILITY TO FOREIGN ORGANIZATIONS

Conditions governing availability:

The LNE is open to organizations of all types and from all countries, subject to the following terms:

- Agreement in principle by the supervisory authorities of the LNE, especially where the country of the requesting body does not have a suitable testing body.
- Preliminary agreement on the financial arrangements for the test.

Information requested:

Those requesting the tests are subject to the general conditions of LNE governing testing: in particular, the laboratory is bound to maintain professional secrecy.

Means of communication with technicians:

All useful information on the means of carrying out the tests are supplied to the requesting parties.

Means of recording and certifying the tests:

The LNE issues certifications of compliance with the regulations and standards.

It is authorized by the Ministry of Transport to carry out tests to show compliance with the Regulations on the Safe Transport of Dangerous Materials.

For type A packaging, certifications are recognized by the regulatory authority.

For type B packaging and for materials of special form, the regulatory authorities issue statements of compliance on presentation of LNE certifications.

Reciprocal agreements have been concluded with the authorities of various countries.

GERMAN DEMOCRATIC REPUBLIC

The Staatliches am für Atomsicherheit und Strahlenshutz provided the following information in its letter of 25 November 1982:

At Brennstoffinstitut Freiburg experimental facilities are available for carrying out the following tests, specified in the IAEA Regulations for the Safe Transport of Radioactive Materials (1973 edition):

(1) 1-m drop test with impact on a cylindrical bar mounted on a flat, rigid and unyielding foundation target.

(2) 9-m drop test with impact on a flat, rigid and unyielding target.

(3) Thermal test: exposure for 30 minutes to an open fire of 800° C.

(4) Water immersion test.

(5) Halogen leak test.

The drop tests (1) and (2) are performed in the drop test facility (Fig. 1 and 2). This facility enables packagings having dimensions up to the following limits to be tested:

Maximum diameter: 1500 mm.
Maximum height: 1800 mm.

The maximum weight of a packaging to be tested is 5000 kg.

During the drop tests it is possible to measure the impact forces (F_{max} = 2 MN) and shock decelerations (a_{max} = 100,000 m/s^2) and to film the deformation process with high-speed cameras (f_{max} = 5000 frames/s).

In tests with very small packagings a guiding device (Fig. 3) can be installed, by means of which the adjusted drop attitude will be maintained along the drop path. In addition, there are computer codes available for the calculation of deformation and impact forces.

The thermal test takes place in an open Diesel-fire within a special building having a floor area of 20 m by 10 m and height of 5 m. The walls and the ceiling of this room are provided with air inlet and smoke outlet openings, respectively, which can be shut. The packagings to be tested can have the same maximum dimensions as given for the drop tests.

During the Thermal test the spatial and temporal temperature distribution, both in the fire and on the packaging surface as well as inside the packaging, can be measured and recorded by means of thermocouples. It is also possible to determine the spatial and temporal temperature distribution in a packaging during the thermal test with a computer code.

The water immersion test is done in a pressure vessel under pressures up to 2 MPa. Packages to be tested may have a maximum side length of 1200 mm and a maximum weight of 5000 kg.

The leak-tightness of a packaging before and after the tests is checked with a halogen leak detector. The lowest leakage rate detectable with this device is 10^{-4} Torr. l/s. The maximum test pressure is 1.5 MPa.

The tests performed on a packaging are described in test reports, which contain all information necessary for compliance with the requirements for Type B packagings.

The testing of transport packagings and the determination of their suitability are carried out on the basis of commercial contracts.

Interested firms and institutions are requested to get in touch with:

Brennstoffinstitut Freiberg

DDR - 9200 Freiberg/Sa.
Halsbrücker Str. 34

Tel. 530

Telex 7-8531

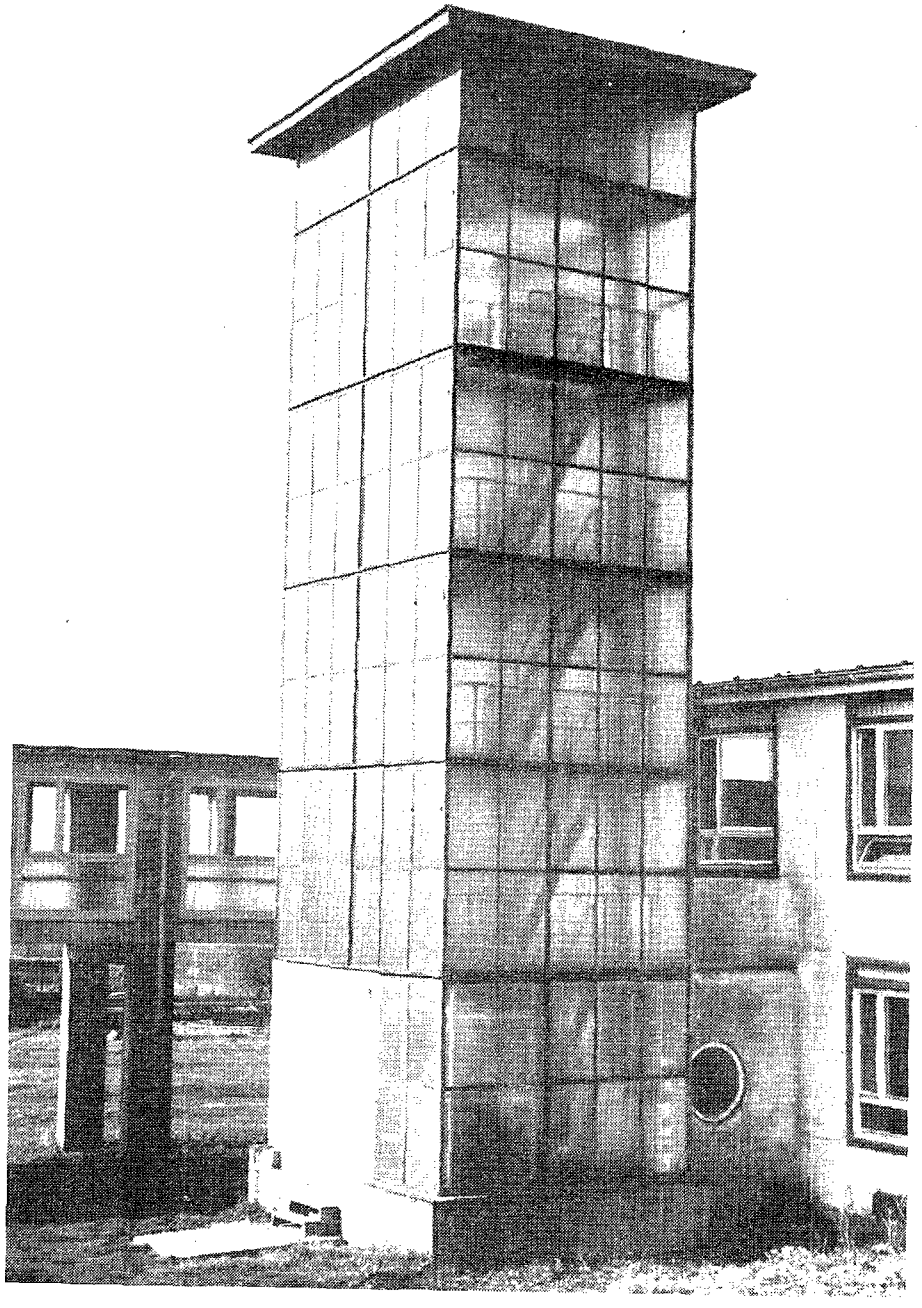


Fig. 1 Total view of the drop-test facility

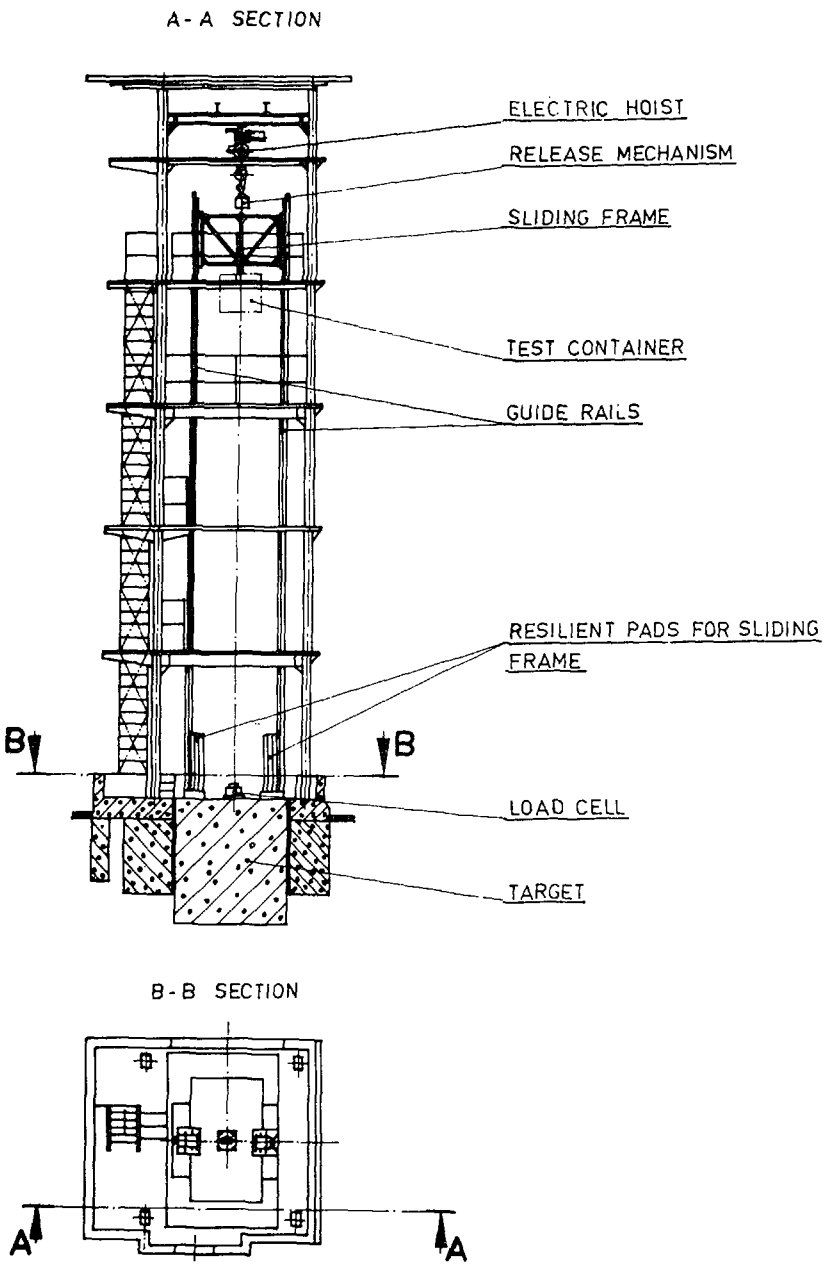


Fig. 2 Sectional view of the drop-test facility

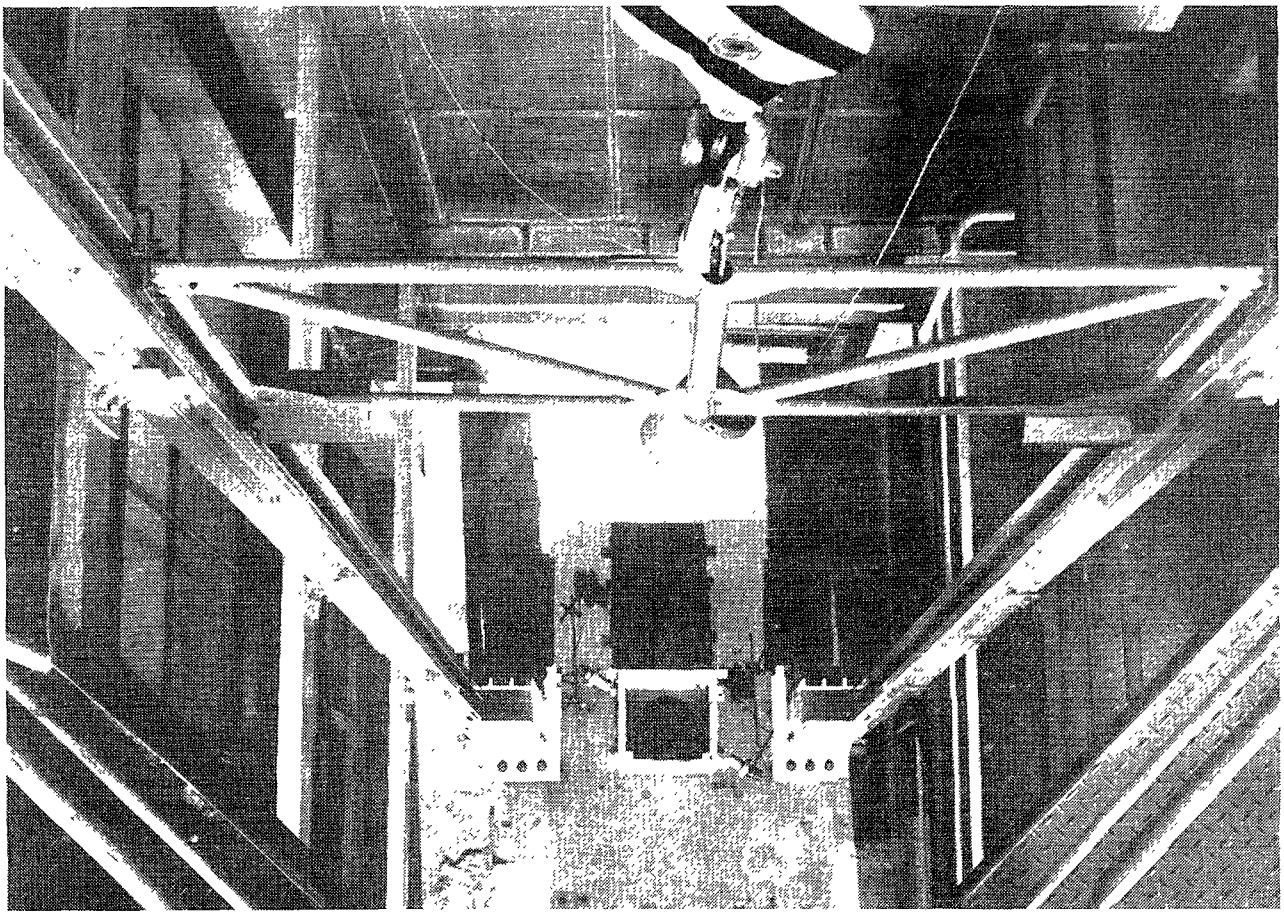


Fig. 3 Drop-test facility with guiding device (seen from above)

GERMANY, FEDERAL REPUBLIC OF

The Permanent Mission of the Federal Republic of Germany to the International Organizations provided the following information in its letter (491.35) dated 1 June 1982.

I. Bundesanstalt für Materialprüfung (BAM)
Unter den Eichen 87
1000 Berlin 45

II. Bleiwerk Goslar KG
Postfach 1220
D-3380 Goslar 1

III. Amersham buchler GmbH & Co. KG
Postfach 1120
D-3300 Braunschweig

I - BUNDESANSTALT FÜR MATERIALPRÜFUNG (BAM)
(Federal Institute for Materials Testing)

1. IDENTIFICATION AND GENERAL INFORMATION

- Title and address of installation:

  Bundesanstalt für Materialprüfung [a)]
  Unter den Eichen 87
  D-1000 Berlin 45
  Telephone (030) 8104-1, Telex 1-83261 bamb d

- Date of establishment:

  First facility (drop test facility) entered into service in 1961

- Operator:

  BAM-Referat 1.02 "Gefahrgutumschließungen aus metallischen Werkstoffen"
  ('Metallic containments for dangerous goods')
  in cooperation with other BAM-departments

- Staff (Status Dec. '82):

  2 graduated engineers
  2 engineers (technical diploma)
  2 further staff members

- General description of sites and routes of access:

  10 ton - drop test facility, Berlin-Grunewald
  (to be entered by special permit only)

  100 ton - drop test facility and open fire test facility,
  D-3306 Lehre - Kampstüh (to be entered by special permit only) -
  nereby Autobahn exit 'Braunschweig Ost'

  All other test sites at BAM, D-1000 Berlin 45, Unter den Eichen 87

2. DESCRIPTION OF FACILITIES AND SERVICES

- **Type A tests [b)]:**

  All tests (water spray test, drop test, compression and penetration test) can be performed by BAM as well as related shielding integrity and leaktightness measurements.

---

a) Subordinate to the Bundesministerium für Wirtschaft (Federal Ministry for Economic Affairs) and acting in certain areas on behalf of the Bundesministerium des Inneren (Federal Ministry of the Interior). In the field of RAM-package testing BAM is the only competent institution due to a guide of the Bundesministerium für Verkehr (Federal Ministry for Transport).

b) Type A tests in the Federal Republic of Germany are allowed to be performed by the applicant himself in accordance with the IAEA-transport regulations.

Type A test facilities

Test facility *) / Characteristics	Water spray test facility	Drop test**) facility (drop height 1,2 m)	Compression test facility
max. sample dimensions	3 m^2	0,7 x 0,9 m	1,2 x 1,2 m
max. sample mass (kg)	1000	250	1000
max. compression force (kN)	---	---	50

*) Facilities of BAM - Lab. 3.34
**) Test temperature range - 40° up to 38 °C;
for larger drop height and sample mass dimensions see under Typ B drop test facilities.

Type B tests:

Drop test facilities

Test facility / Characteristics	Building 12 facility*)		Grunewald facility **) (open air fac.)	Lehre ***) facility (open air fac.)
	Guided free drop	Free drop	Free drop	Free drop
Drop height max. (m)	9	9	15	20
Max. sample mass (t)	2	4	9	100
Impact area of the target, max (m^2)	1x0,7	2x2	2x4	2x6
Target mass (t)	60	60	90	1000

*) detailed datas in Fig. 1,2
**) detailed datas in Fig. 3
***) detailed datas in Fig. 4

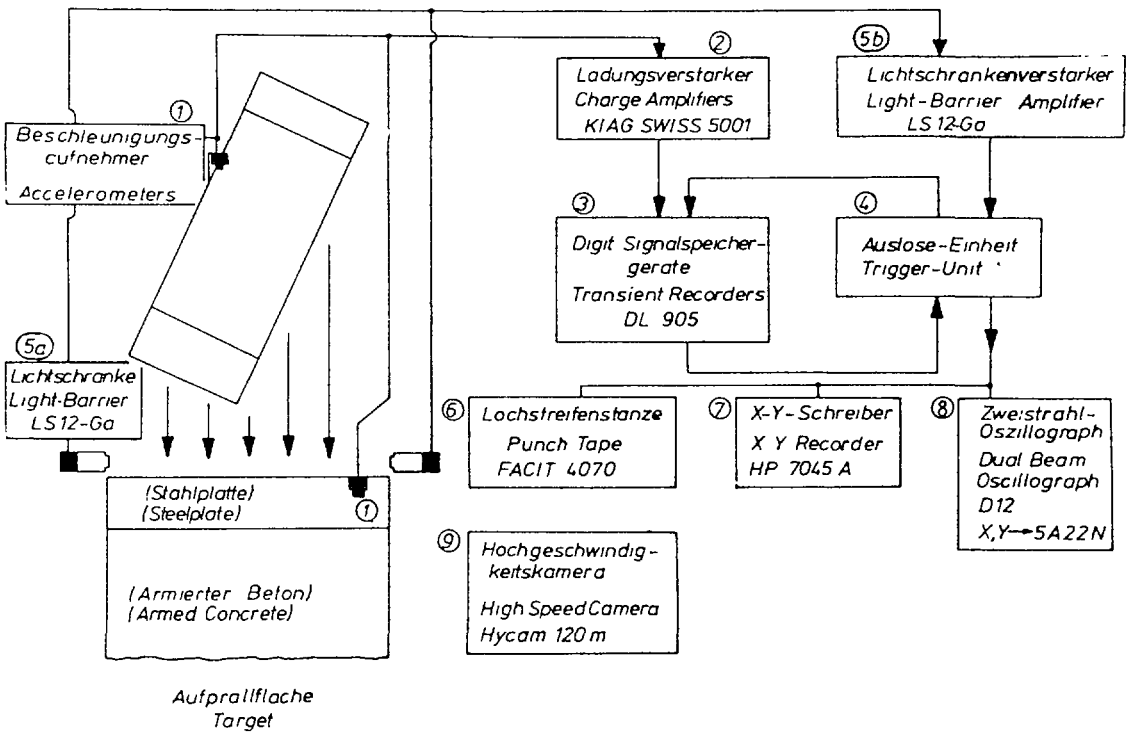
Each facility equipped with release system, working momentfree. Guiding system of Building 12 facility to avoid declination of drop position

of light weight specimens. Setting of every drop position possible by use of adaptable lifting devices.

Original or modelled IAEA punches to be fitted to the targets.

Deceleration measurements of impact with up to 12 channels and / or strain gauge measurements possible using the following test set up:

Test set up for deceleration and strain gauge measurements:



Electronical filters or computer aided filtering method (selective elimination of frequencies by Fourier-analysis). Recording of impact by photographie camera, 16 mm-film camera and high speed film camera; the last one equipped with high effective lighting system, e.g. a high power stroboscope resulting in frequencies up to 10.000 frames/s.

Recording of deformations, loss of bolt torques a.o. by conventional measuring equipment.

Quality assurance measures used to qualify the test results including calibration of measuring equipment, application and control of compliance of / with written test and measuring procedures and data sheets.

Thermal test facilities

Characteristics \ Test facility	Oil burner furnaces*)		Lehre Open fire test facility **)	Electrical furnace ***)
	support test facility	cover test facility		
Type of heating device	Oil burner controlled by standard five curve		Open oil fire with wind-shield	Electrical, thyristor-controlled resistance heating
Effective volume, max.				
width (m)	2	2	3	1
depth (m)	2	2	8	1
height (m)	3	2	-	1
Test object mass, max.	Permissible floor loading, 200 kg/m^2		100 t	1000 kg

*) Facilities of BAM - Lab. 2.41
**) see detailled datas in Fig. 5
***) see detailled datas in Fig. 6

Measurement of fire and test object temperatures by steelcoated thermocouples and multipoint printers. Control of temperature maxima by 'thermo-taps'.

Equipment for measurement of internal pressures.

Calculation of fire test with the help of a one-dimensional computer program.

Testing device for the measurement of temperature and pressure dependent heat convectivity figures.

Immersion test facilities

Except for specimens up to volumes of 200 l no facilities available to perform immersion tests by experiment.

Certification of safety against external pressure delivered by calculation of stresses and stability according to German and foreign pressure vessel codes.

Leak-testing

Equipments and experienced staff available (supported by Lab. 6.32) to perform every appropriate kind of leak-testing:

- Helium - massspectrometers for all types of Helium-testing
- Equipment for pressure rise and pressure drop testing
- Equipment for bubble and soap solution testing

Range of sensivities down to 10^{-10} mbarl/s.

Special form material test

Equipment and experienced staff in BAM available to perform all IAEA and ISO*)-tests for special form radioactive material.
According to German traffic law BAM (Lab. 6.32) is the competent authority to perform these tests and to issue the IAEA certificate of approval.

3. ADDITIONAL FACILITIES AND SERVICES

Equipment and experienced staff available to perform mechanical testings of samples and structures under creep, static, dynamic and vibration loads according to national and international test standards:

- static loads	up to 20 MN
- dynamic loads (servohydraulic)	up to 13 MN
- vibration load vector (electro-dynamic shaker);	up to 30 kN
frequencies	up to 5 kH
- test temperture range	4K to 1500K

Chemical and physical testings and investigations on metals, organic materials and minerals.

Evaluation of the behaviour of materials under irradiation.

Evalution of the physical and chemical compatibility of materials (corrosion investigations).

*) ISO 2919 Sealed radioactive sources - classification

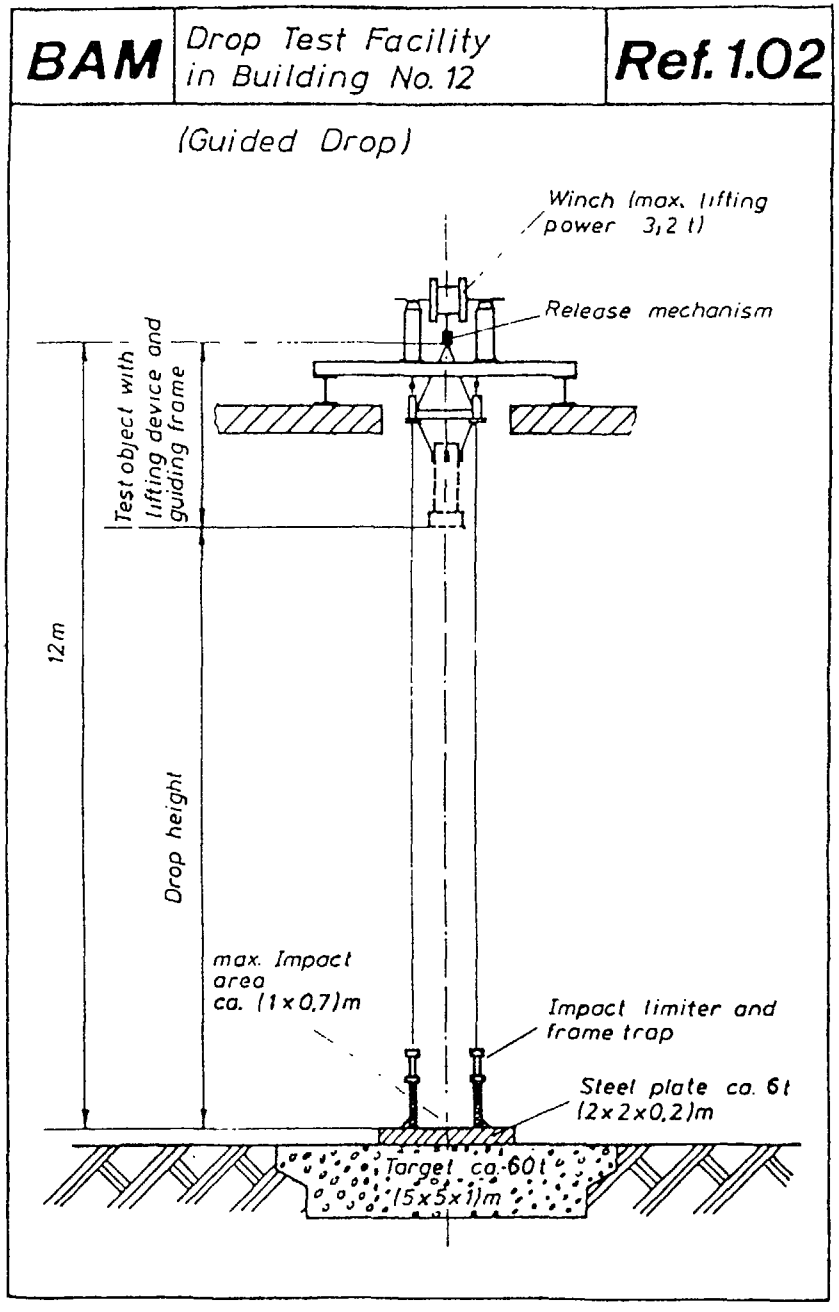


Figure 1

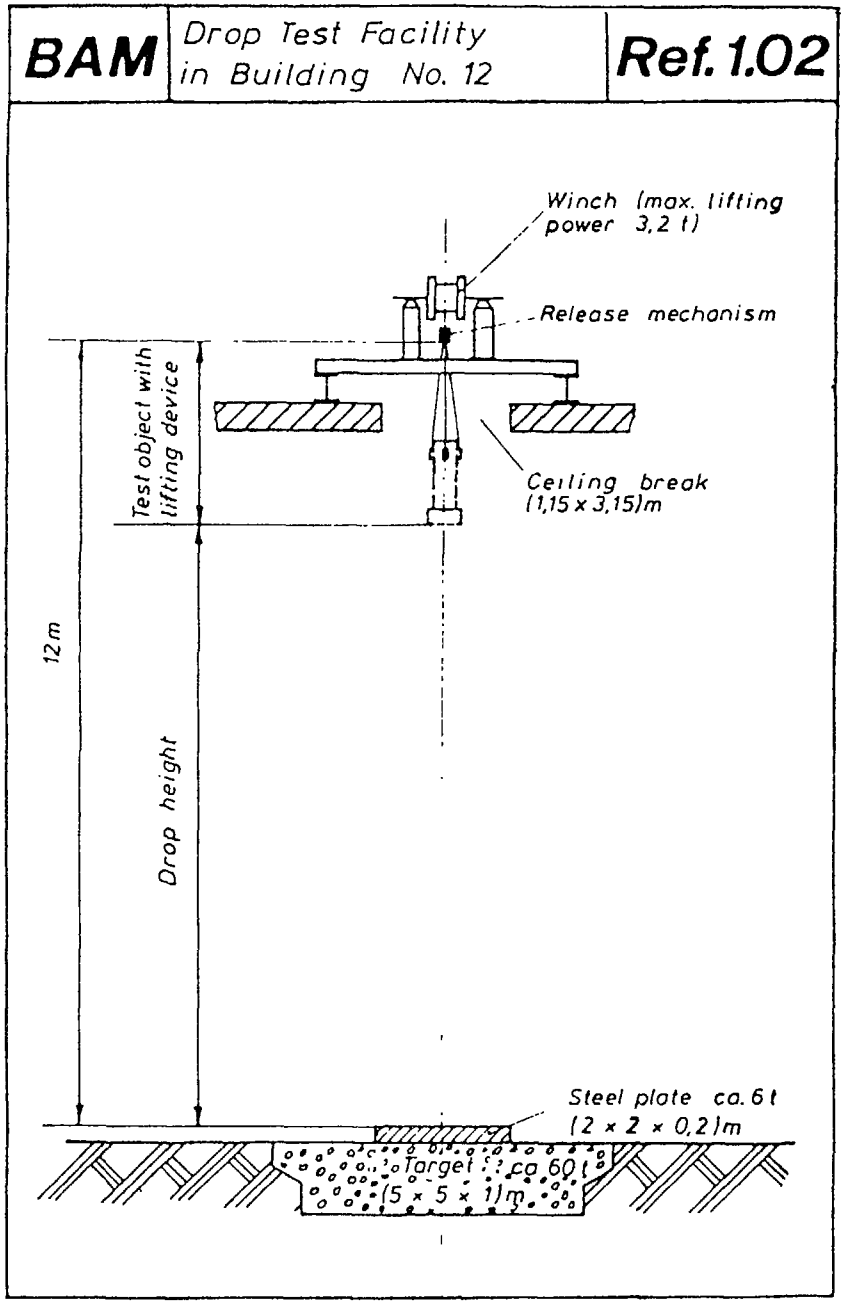


Figure 2

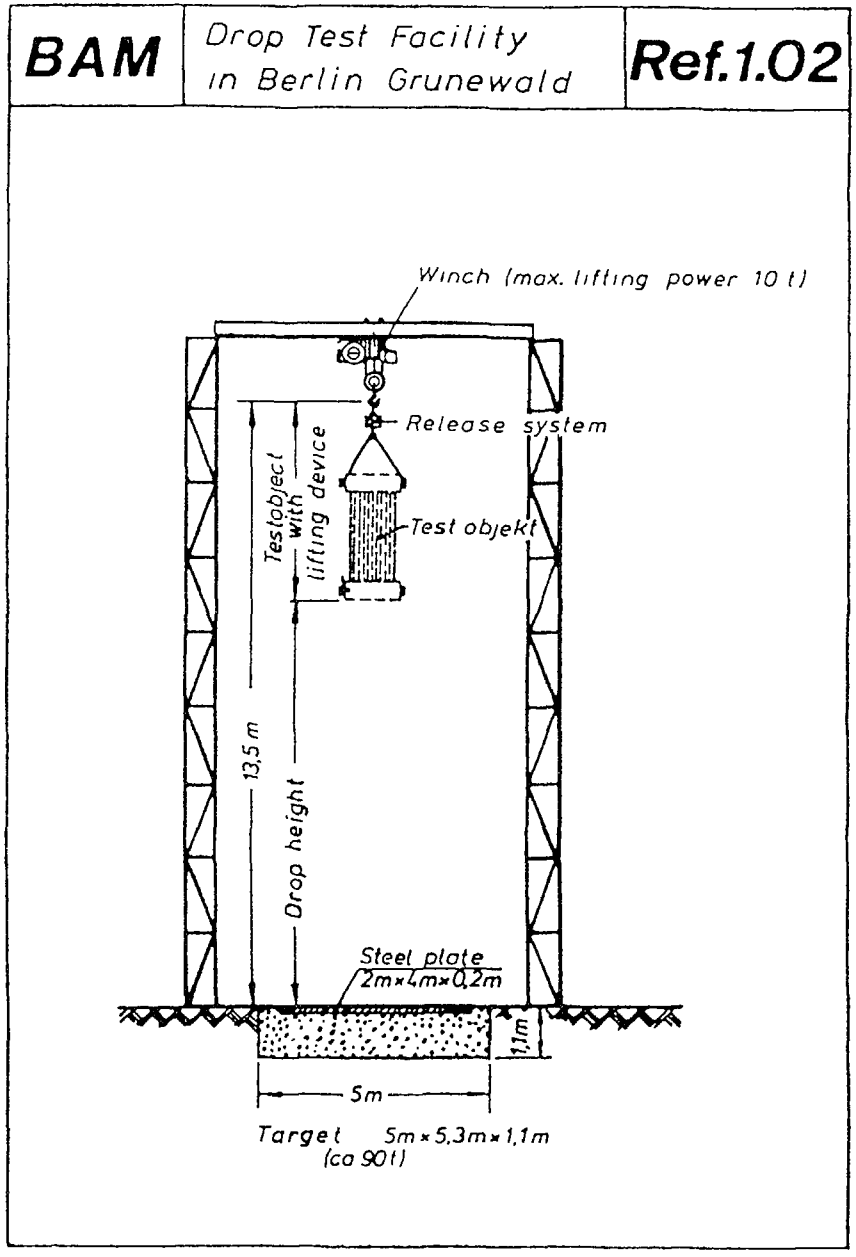


Figure 3

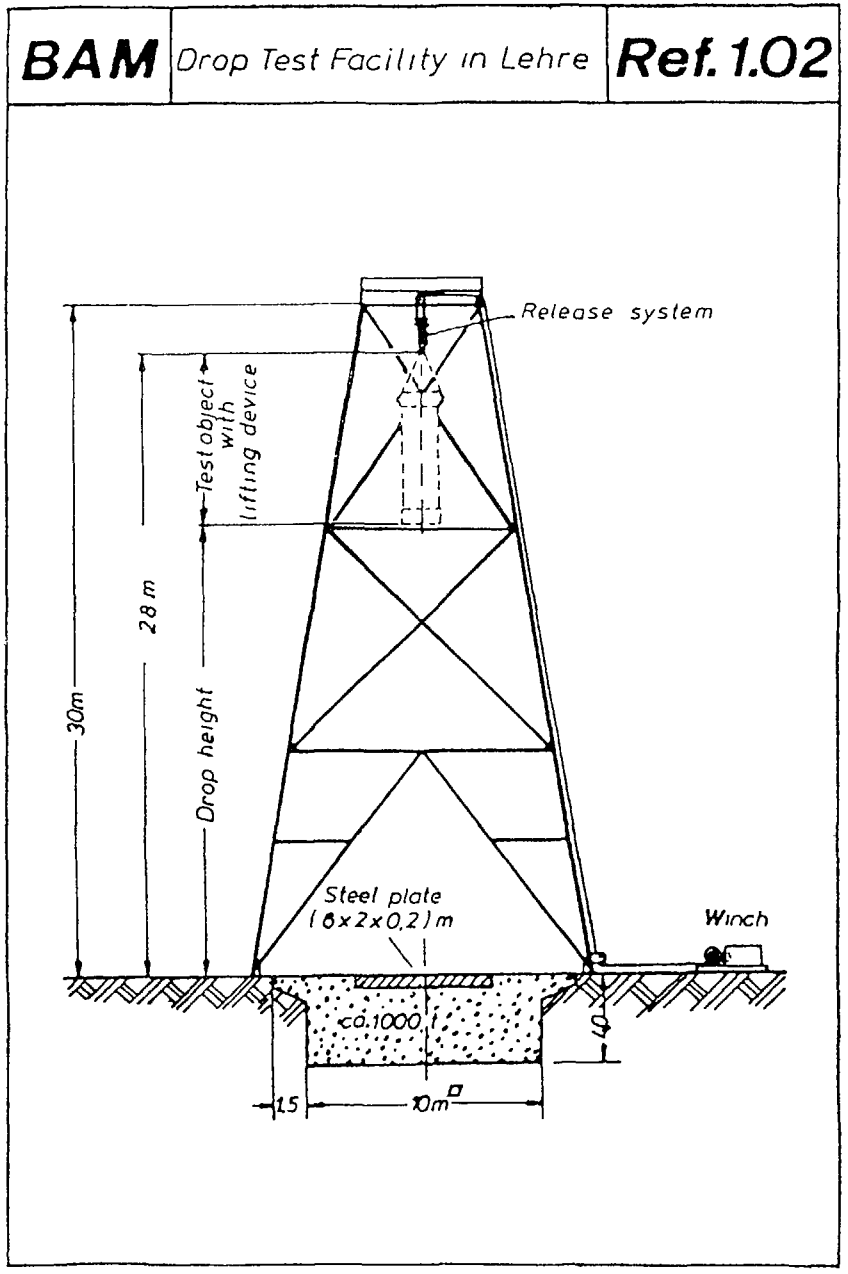


Figure 4

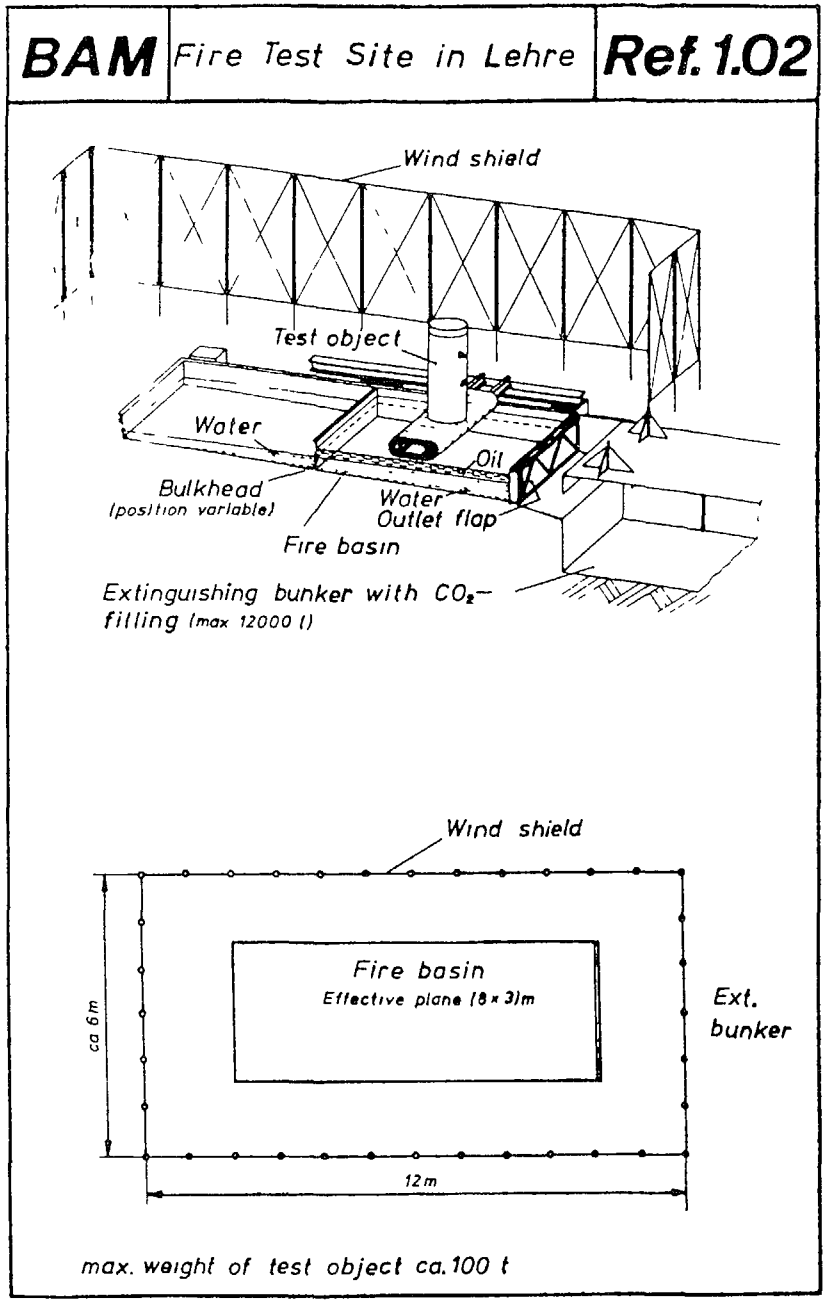


Figure 5

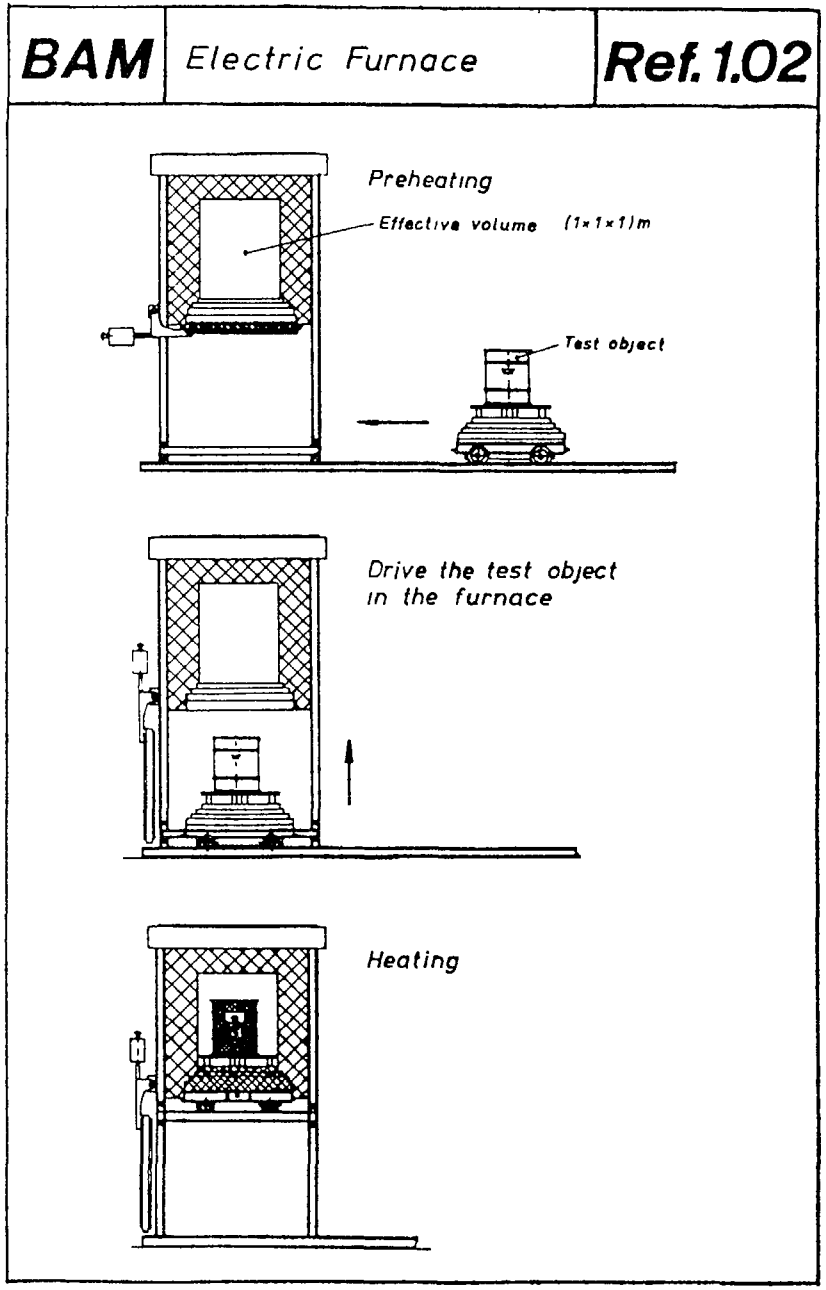


Figure 6

II Bleiwerk Goslar KG
Postfach 1220
D-3380 Goslar 1

Excerpt from a letter of Bleiwerk Goslar KG to the Federal Ministry of the Interior:

" The tests required by IAEA regulations are partly performed by our quality assurance personnel. This applies in particular to the following tests:

1. Type A tests

Water spray test

Free drop test

- For packaging for solid material;
- For packaging for liquids and gases.

Compression tests

Leak-tightness tests (helium leak tests)

Tests on shielding

2. Type B tests

Leak-tightness tests (helium leak tests)

Tests on shielding (radiographic test using a cobalt source)

Compression tests

All other tests are carried out by the Federal Institute for Materials Testing (BAM).

We have a computer program available which can be used in place of the thermal test to determine the suitability of the transport packaging. "

III Amersham Buchler GmbH & Co. KG
Postfach 1120
D-3300 Braunschweig

Excerpt from a letter of Amersham Buchler GmbH & Co. to the Federal Ministry of the Interior:

" Since we ourselves have for many years tested the Type A transport packaging which we use in accordance with the regulations in force at the time, we have acquired a certain amount of experience in this field and have available the necessary test equipment.

Accordingly, we believe we are in a position to perform tests for other users of Type A packaging.

We should point out one limitation, however, which is that it is not possible for us to test every kind of Type A packaging.

The types of packaging we can test are those which are normally used for shipping radiopharmaceuticals. "

ITALY

The following information was provided by the Embassy of Italy in its letter of 11 October 1982. Additional information taken during the Coordination Meeting on Safe Transport held at the ENEA, Rome in March 1983:

ENEA (formerly CNEN), Italian Authority responsible for approving package designs for transport of special radioactive and fissile materials, informs that container testing mentioned under chapter II and III of the Guidebook "Regulations for the safe transport of radioactive materials" will be performed at the Pisa University testing station (Dpt. of Nuclear Plants) near Scalbatraio, Pisa - S. Piero a Grado, that ENEA has declared to be fit to such purpose.

The testing station fitness has been assessed on the basis of a QUALITY ASSURANCE programme set up by the station.

The whole equipment required for testing containers or scale specimen up to a maximum weight of 10 tons is presently available at the Scalbatraio testing station. All tests concerning their capability to undergo both current (marginals 709 to 717 of the IAEA Regulations, 1973) and accidental (marginals 718 to 721) transport conditions can also be performed at Scalbatraio, along with water penetration tests for packages containing fissile materials (marginals 722 to 724).

All tests performed at this station (or at different stations-including foreign ones - declared to be fit by ENEA) will be used to the purpose of the authorization procedure mentioned in the ENEA-DISP Technical Guidebook No. 5.

On the grounds of the technical enquiry carried out on the documents supplied by the Applicant (including report on tests), ENEA will release an APPROVAL CERTIFICATE for individual package designs, attesting that the requirements of both national and international RID and ADR regulations, as well as those of the INCO and ATA agreements are met. ENEA has already sent to IAEA samples of such certificates.

As to the possibility that the Scalbatraio testing station also performs tests on containers manufactured in other Countries, the financial conditions of such service and the information about quality, quantity and limits of such tests, the reference person is Professor Giuseppe Forasassi, Dpt. of Nuclear Plants, Faculty of Engineering, Pisa University.

TRANSPORT PACKAGING TEST INSTALLATION

1. IDENTIFICATION AND GENERAL INFORMATION

a) Title address of installation - Laboratorio dello Scalbatraio Comitato Nazionale Energia Nucleare c/o Istituto Impianti Nucleare - Università di Pisa, Via Diotisalvi, 2 _ 56100 PISA (ITALY).

b) Date of establishment - Established in 1970 and enlarged in 1978.

c) Operated by - Government Establishment operated by Istituto di Impianti Nucleari - Università di Pisa in collaboration with CNEN.

d) Number of staff employed - At present the staff comprises 3÷6 (depending on actual necessity) qualified engineers of different disciplines: nuclear, mechanical, electronics and 3÷8 skilled and qualified tecnicians.

e) General description of site and routes of access - The test station is located 12 km from Pisa in a pinetree forest and is accessible by national roads and rural road (4 km). Major sea port (Livorno) and airport (Pisa) are within a distance of 20 km from the station.

2. DESCRIPTION OF FACILITIES AND SERVICES

a) General description

The CNEN test station (see photo n. 1) is equipped to carry out type A and type B tests according to the requirements of the IAEA Regulations for the safe transport of radioactive materials.

Two types of drop test installation exist: 1) fixed drop tower suitable for models and prototypes weighing up to 2.3 tons; 2) mobile installation for models and prototypes up to 15 tons.

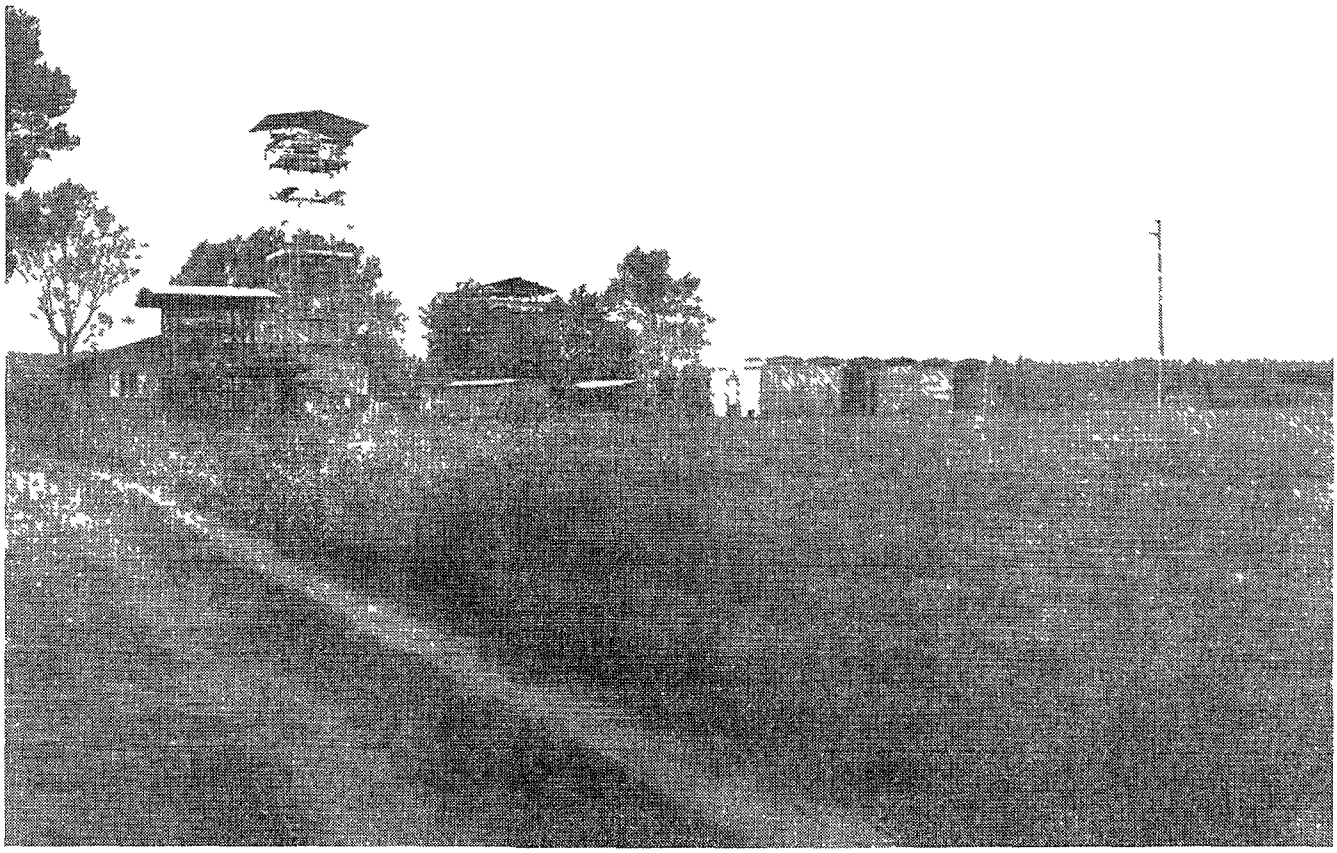


Fig. 1 - Scalbatraio Center

Details are as follows:

b) Type A tests

Water spray test : Equipment capable to simulate standard rainfall as required by IAEA Regulations.

Free drop test : - up to 2 tons and 11 m on a reinforced concrete 2 x 2 m^2 target lined with 50 mm thick steel plate.

- up to 15 tons and 20 m on a reinforced concrete 4 x 4 m^2 target lined with 50 mm thick steel plate;suspension is obtained by a hoist and various forms of rigging are available to obtain the required impact angle.

The release mechanism is electrically operated.

Compression test : Compression tests are carried using either dead weights or hydraulic jacks.

Penetration test : Penetration test rig according to IAEA Standard.

Shielding integrity test : Using a standard source and monitoring the specimen by using either TLD dosemeters or film dosemeters.

Containment testing: Leakage testing by pressure drop method or by using radioactive tracers.

c) Type B tests

Mechanical tests : 9 m drop test and 1 m punch test facilities available as follows:

Maximum weight capacity:

Main test rig: 2 tons

Large capacity rig: 15 tons

Maximum height capacity:

Main test rig: 11 m (drop tower) (see photo 2)

Large capacity rig: 20 m (mobile crane)

Release mechanism : Explosive bolts eletrically actuated.

Attitude control : Obtained by metallic cables.

Targets : 1) Main test rig : Reinforced concrete lined with a 50 mm thick steel 2 x 2 m^2

2) Large capacity rig : Reinforced concrete lined with a 50 mm thick steel plate 4 x 4m^2.

Photographic recording of impacts :-Still photography using 35 mm or Polaroid cameras

-Cine photography high speed 16 mm cine cameras.

Scale model testing: Possibility in accordance with the maximum weight and dimensions capability of the test facilities.

Deceleration and deformation measurements : 1) Strain gauges, load celles and accelerometers with suitable conditioning instrumentation

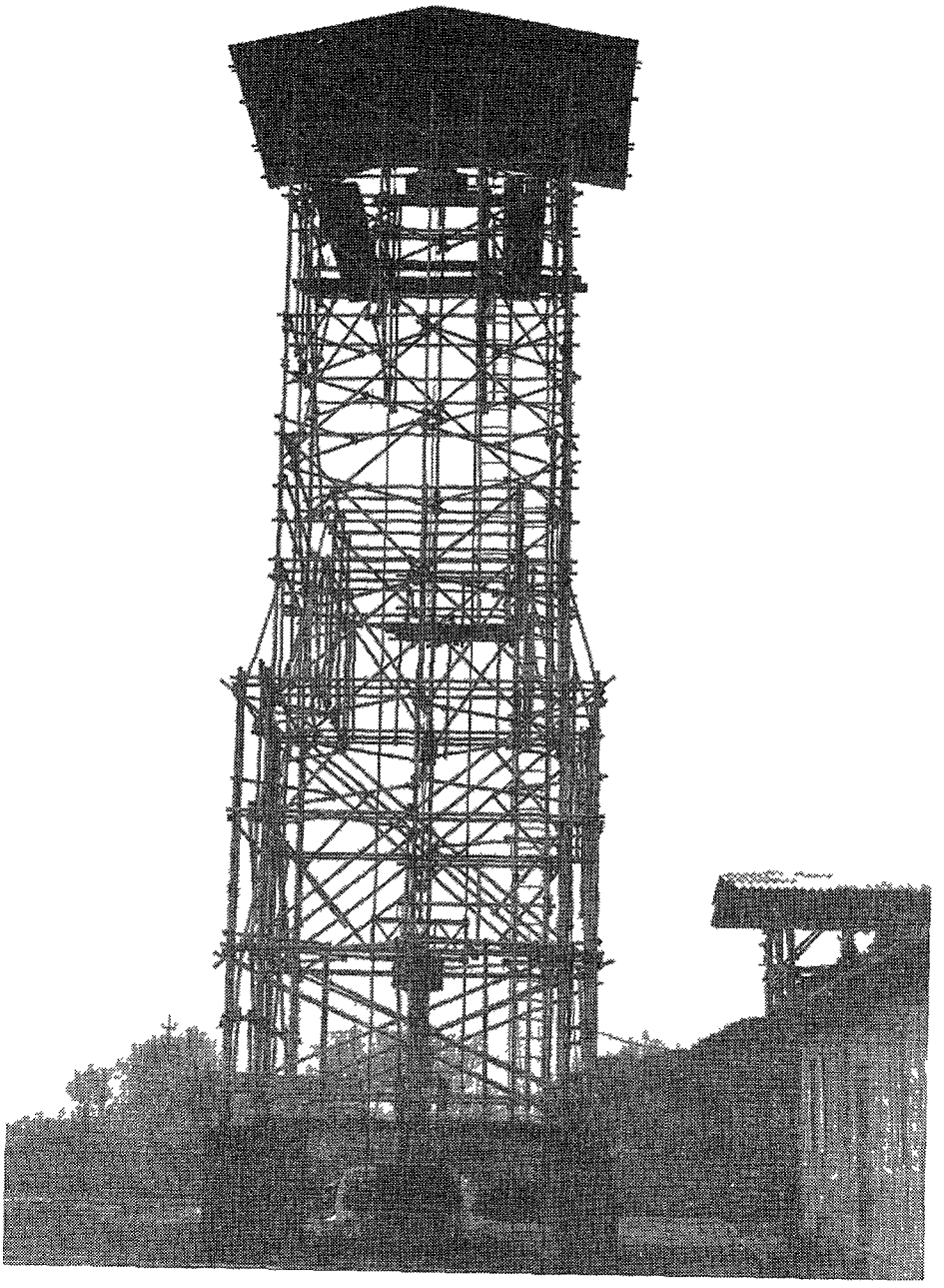


Fig. 2 - Drop tower

2) 2 magnetic Tape recorders with 14 channels each

3) Digital computer with 40 channels input capability for on line data registration and subsequent elaboration.

Thermal tests : Open fire (oil fired) screened pool 2 x 2 m^2.
Temperatures are detected by thermocouples with

12 channels system. The system can be expanded up to 40 channels.

Furnace test can be performed outside the test site.

Water immersion test : 1) Actual immersion up to 0.9 meter.

2) Simulated depth conditions are obtained by the use of a pressurized vessel (see photo n. 3) having an internal diameter of 2 meter and 3 meter high. The maximum pressure is 6 atm measured by means of pressure gauges.

Integrity test : Using standard source and monitoring the specimen by TLD dosemeters or film dosemeters.

Containment test : Leakage testing can be performed by pressure drop method or by using radioactive tracers.

d) Special form material test:

can be carried out according to IAEA requirements using dummy specimens.

3. ADDITIONAL FACILITIES AND SERVICES

Material testing: can be carried out using the facilities available at the Scientific Institutes of Pisa University.

Vibration testing: as above.

International Availability of Services

All test facilities are available to national and international customers and are offered as a complete service including staff and equipments. Being the test station a government institution quotations are made on the basis of expense reimbursement.

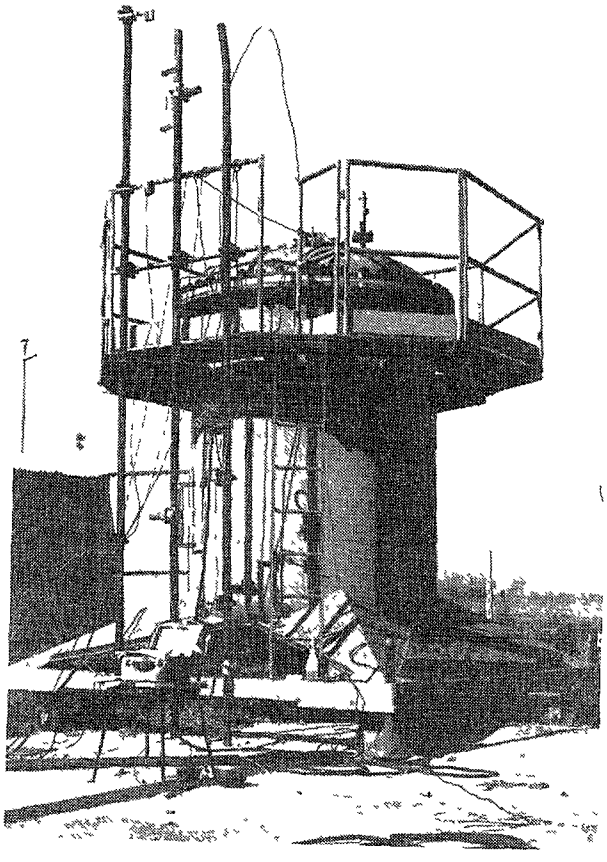


Fig. 3 - Pressurized vessel for immersion tests

JAPAN

The information contained in the following pages were taken during the meeting of the Technical Committee on Transport Package Test Standards held in Tokyo, September 1981.

TEST FOR DEMONSTRATING THE RELIABILITY OF CONTAINERS USED FOR TRANSPORT OF SPENT FUEL

TAKEYAMA FLASK TEST YARD

SEPTEMBER, 1981

CENTRAL RESEARCH INSTITUTE OF
ELECTRIC POWER INDUSTRY, JAPAN

TAKEYAMA FLASK TEST YARD:

Outline of the Test Facilities

The bird's eye view of these test facilities is shown in Figure 1, and the rough arrangement of this yard is shown in the plan at the middle top of this figure in the following order:

(A) Drop impact test facility

(B) Sprinkler test facility

(C) High pressure test facility

(D) Heat transmission test facility

(E) Thermal test facility

(F) Shielding test facility

(G) Measurement system of three dimensional coordinator

(H) Sliding house

(I) Laboratory and others

The main apparatuses or equipment of each facility and their purpose, size and capacity, etc. are discribed in Table 1.

The testing conditions are itemized into the following four categories:

1) Tests under normal testing conditions

(1) Sprinkling test

Water corresponding to rainfall of 50mm per hour will be sprayed againt the flask for 1 hour.

(2) Drop impact test

The flask will be dropped, in such a position so as to suffer the maximum damage, from a height of 30cm on a steel plate placed over a concrete bed.

(3) Collapse test

A rod with a semi-spherical end, weighing 6 kg and of diameter 3.2 cm will be dropped onto a most vulnerable part of the flask from a heigh of 1 meter.

(4) Heat transmission test

A flask containing heat sources corresponding to the decay heat of the spent nuclear fuel assemblies will be placed so as to keep an ambient temperature at 38°C

for a week, and the temperatures inside and outside of the flask, changes in the cavity water pressure owing to the temperature rising etc. will be measured and evaluated.

2) Tests under hypothetical testing conditions

These hypothetical testing conditions are specified by the regulation of the IAEA and Japan.

(1) Drop impact test-I

A flask will be dropped from a height of 9 meters onto a steel plate over a concrete bed, in such a position that the flask may suffer to the maximum damage.

(2) Drop impact test-II

A flask will be dropped, in such a position that it may suffer the maximum damage, from a height of 1 meter onto a round mild steel rod of 15 cm diameter and 20 cm length, which is fixed upright.

(3) Thermal test

In anticipation of the possibility that a flask may be exposed to a fire during transportation, the flask will be tested at 800°C or higher for 30 minutes or longer in a heating furnace.

(4) Immersion test

A flask will be immersed for 8 hours or longer under a water pressure corresponding to a water depth of 15 meters in a high pressure water vessel, so as to check the water-tightness of the flask.

(5) Heat transmission test

After the tests (1) - (4) mentioned above, a heat transmission test will be conducted in the same manner.

3) High pressure test

The test is not yet specified by the IAEA regulations, but Japan has added this test assuming the flask is submerged into the sea 3,000 meters deep during the sea transportation,

which possibility exists in Japan because most of the spent fuel transportation must be done by sea in Japan.
The flask will be installed in a high pressure water vessel and tested at pressure up to 300 kg/cm^2 and the deformations, behavior and water-tightness of the flask measured and checked.

4) Performance tests

The performance tests concerning the tightness and shielding of the flask will be carried out before and after each test under normal and hypothetical conditions, so as to verify that the flask meets the criteria requested by the regulations.

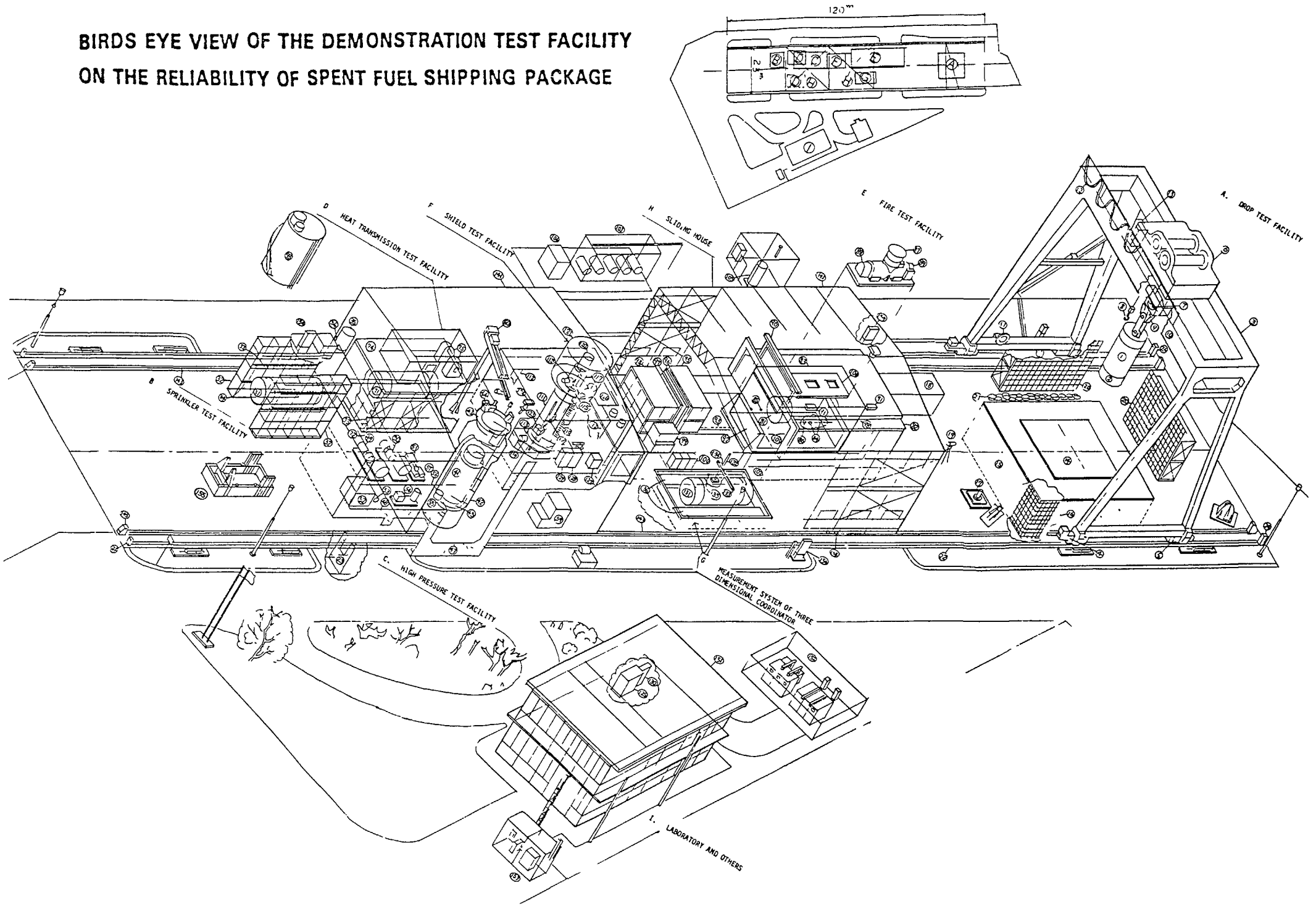
(1) Tightness test

For the purpose of determining and evaluating the tightness performance of the flask before and after the various tests, the leakage rate will be measured and evaluated by the helium leak method and the vacuum manometer method.

(2) Shielding test

For the purpose of determining and evaluating the shield performance of the flask before and after the various tests, a gamma ray source and neutron source will be placed in the flask, and the radiation does rate outside of the flask will be measured and evaluated.

BIRDS EYE VIEW OF THE DEMONSTRATION TEST FACILITY ON THE RELIABILITY OF SPENT FUEL SHIPPING PACKAGE



A. DROP TEST FACILITY

1 Flask
2. Flask absorber
3. 120^{t} travelling crane
4. Crane travelling system
5. Crane travelling system
6. Whisting and travelling system (Crab)
7. 120^{t} hook
8. 25^{t} hook
9. Flask suspension and drop system
10. Drop impact absorber
11. Electric cable reel
12. Electric cable
13. Crane operator room
14. Steel plate of drop test bed
15. Drop test bed
16. Arrangement of reinforcement of drop T.B.
17. Penetration test bed
18. Data register panel room
19. High speed camera
20. Back screen
21. Sand back
22. Crane rail
23. Bed of crane and travelling shelter
24. Crane stopper

B. SPRINKLER TEST FACILITY

31. Flask
32. Steel frame stage
33. Sprinkler head
34. Sprinkler head
35. Water tank of S T.F.
36. Sprinkler pump

C. HIGH PRESSURE TEST FACILITY

41. Flask
42. High pressure test vessel
43. Lid of H.P.T.T.
44. Sliding system of lid of H.P.T.T.
45. High pressure water
46.
47. Section of pit of H.P.T.T.
48. Floor of high pressure pump room
49. No.1 High pressure pump
50. No.2 High pressure pump
51. No.3 High pressure pump
52. Brine tank
53. Brine pump
54. Compressor
55. High pressure circulation pump
56. Floor of power panel room
57. Power panel room
58 Make up feed tank
59. Data register panel of H.P.T.F.
60. Swing jib crane

D. HEAT TRANSMISSION TEST FACILITY

71 Flask
72. Outer wall of H.T.T F.
73. Inner wall of H.T.T.F.
74. Removable ceiling of H.T.T.F.
75. Circulation blower

E. THERMAL TEST FACILITY

81. Flask
82. Thermal test housing
83. Thermal test furnace
84. Gas burner (Upper) 5 x 2
85. Gas burner (Lower) 5 x 2
86. Furnace peep hole
87. Removable stack
88. After burner
89. After burner
90. Sliding furnace door
91. Lift system of sliding furnace door
92. Truck for flask
93. Chain to move flask truckey
94. Hood
95. Hood
96. Hood
97. Hood
98. Blower room
99. Control panel of T.T.F.
100. Data register panel of T.T.F.
101. Upper burner adjusting collidor
102. Lower burner adjusting collidor
103. LPG
104. Vapor riser
105. Hot water boiler
106. Bed for removable stack

F. SHIELD TEST FACILITY

111. Flask
112. Shielding wall
113. Flask turning bed
114. Turning motor of flask turning bed
115. Flask upper collar
116 Shielding plate
117. Radiation source container
118. Lid of radiation source container
119. Radiation source
120. Driving system of radiation source
121 Shelter
122 Detector
123. Detector driving mechanism
124. Monitor camera
125. Control panel of S.T.F. (*)
126. Radiation source store
127. Control panel of flask turning bed
128. Control panel of driving system of radiation source
129. Control panel of driving system of detector
130. Data register panel of S.T.F.

G. MEASUREMENT SYSTEM OF THREE DIMENSIONAL COORDINATOR

131. Flask
132. Measurement system of three dimensional coordinator
133. Senser
134. Counter unit
135. Control unit
136. Surface table of M S.O.T D.C.

H. SLIDING HOUSE

141. Sliding house A
142. Sliding house B
143. Rail for sliding house
144. Wheels for sliding house
145. Stopper of sliding house

I. LABORATORY AND OTHERS

151. Laboratory
152. Transformer
153. Boiler
154. Fire hydrant
155. Skid

(*) 2F of laboratory

Fig. 1

TAKEYAMA FLASK TESTING YARD
CENTRAL RESEARCH INSTITUTE OF ELECTRIC POWER INDUSTRY

Table 1 TAKEYAMA FLASK TEST YARD

Civil Engineering Technical Laboratory, Central Research Institute of Electric Power Industry

Place: Yokosuka City, Kanagawa Prefecture (60 Km South of Tokyo)
Test Program for Demonstrating the Reliability of Containers used for Transport of Spent Fuel:
8 year program since 1977

Area : Testing Yard Only ; $23^{m}W \times 120^{m}L$

Test Facility	Ⓐ Drop Impact Test F.	Ⓑ Sprinkler T. F.	Ⓒ High Pressure T. F.
Main Apparatus or Equipment ° purpose △ Specification	◎ 120t travelling crane ° dropping tower ° carrying flask over the yard △ hoisting L. 120t, 25t lift height 20m span 23m rail length 120m ◎ Test bed △ reinforced concrete covered with st. pt. 12mW x 12mL x 4.5mD total weight 1,500t ◎ Puncture test bed ◎ Back screen 2	◎ Sprinkler heads 2 sets • rainfall of 50 mm/h ◎ Steel frame stage for sprinkler H. 2 sets ImW x 7mL x 6mH ◎ Sprinkler pump ◎ Water tank	◎ High pressure test vessel • High pressure T. up to 500 kg/cm^2 ° Immersion test △ 3mI.D x 6mI.H total Ht 10.8m inner volume 50m^3 total weight 430t ◎ Pit for H. P. T. vessel △ 8 mW x 6mL x 10mD ◎ Pit for high P. pumps 8 mW x 10.5mL x 6mD ◎ High pressure pump 3 sets ◎ Swing jib crane
Instrumentation	1 set Container for data acquision High speed camera		1 set

Ⓓ Heat Transmission T. F.	Ⓔ Thermal Test F.	Ⓕ Shielding Test F.	Others
◎ Heat transmission test hood • to keep constant temp. △ double wall hood 5. 5mI. W x 8. 5mI. L. x 4. 0mI. H. ◎ Cooling and heating system ◎ Simulated heater for fuel assy © Electric power equipment	◎ Furnace • Thermal test △ directed-fired heating furnace 5mI. W x 8. 5mI. L. x 5mI. H. burners: 10 (up) 10 (L) blowers fuel : LPG ◎ Sliding furnace door ◎ Truck for flask 4.6 mW x 9.8mL drived electric motor chain & sprocket ◎ Hoods 4 sets ◎ Removable stack with after burners	◎ Shielding wall △ 40 - 50 cm thick concrete 8mI. W. x 8mI. L. x x 7. 2mI. H. ◎ Radiation sources △ cylindrical surface source neutron S. 252 cf/mgr Gamma S. 60 Co 200Ci ◎ Radiation S. container ◎ Radiaton S. driving mechanism ◎ Flask turning bed 2. 5m D. ◎ Radiation store	□Ⓖ Measurement System of Three Dimensional Coordinator △ surface table counter unit □Ⓗ Sliding House 2 △ 20mW x 20mL x 11mH rail length 120m □Ⓘ Laboratory and Others
◎ 1 set for temperature & pressure ◎ Atmospheric phenomena measuring equipment	◎ 1 set 200 temperatures	◎ 1 set Control panel of S. T. F and Data register panels -- (2 F of Laboratory)	

1. Flask
2. Shock absorber of flask
3. 120^{t} travelling crane
4. Crane travelling system
5. Crane travelling system
6. Whisting and travelling system (Crab)
7. 120^{t} hook
8. 25^{t} hook
9. Flask suspension and drop system
10. Drop impact absorber (Horizontal Drop only)
11. Electric cable reel
12. Electric cable
13. Crane operator room
14. Steel plate of drop test platform
15. Drop test bed
16. Arrangement of reinforcement of drop T.B.
17. Puncture test target
18. Data register panel container for data acquisition
19. High-Speed Camera
20. Back screen
21. Sand back
22. Crane rail
23. Bed of crane and travelling shelter
24. Crane stopper

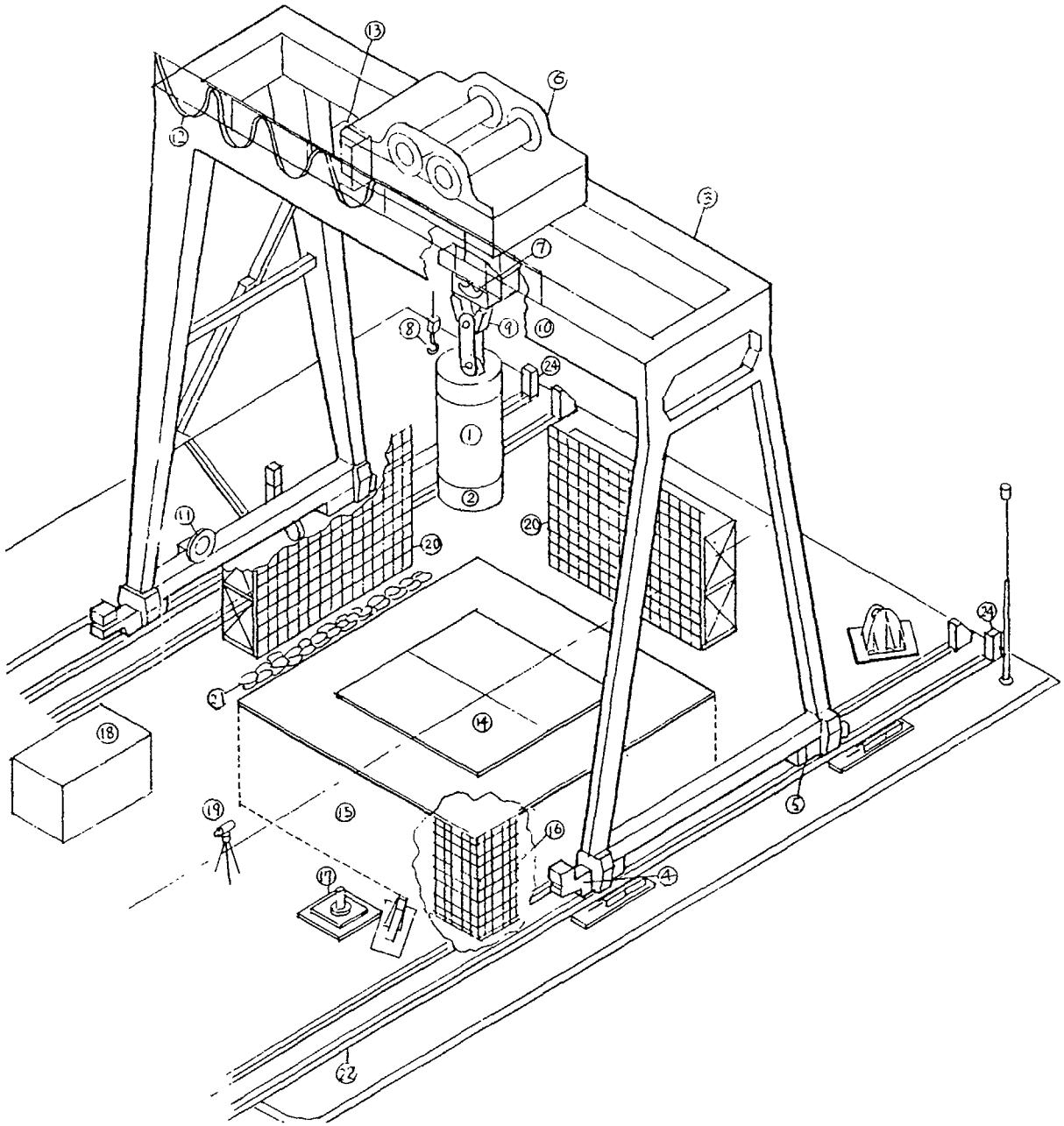


Fig. 1-A Drop Test Facility

41. Flask
42. High pressure test vessel
43. Lid of H.P.T.T.
44. Sliding system of lid of H.P.T.T.
45. High pressure water
46.
47. Section of pit of H.P.T.T.
48. Floor of high pressure pump room
49. No.1 High pressure pump
50. No.2 High pressure pump
51. No.3 High pressure pump
52. Brine tank
53. Brine pump
54. Compressor
55. High pressure circulation pump
56. Floor of power panel room
57. Power panel room
58. **Make up feed tank**
59. **Data register panel of H.P.T.F.**
60. **Swing jib crane**

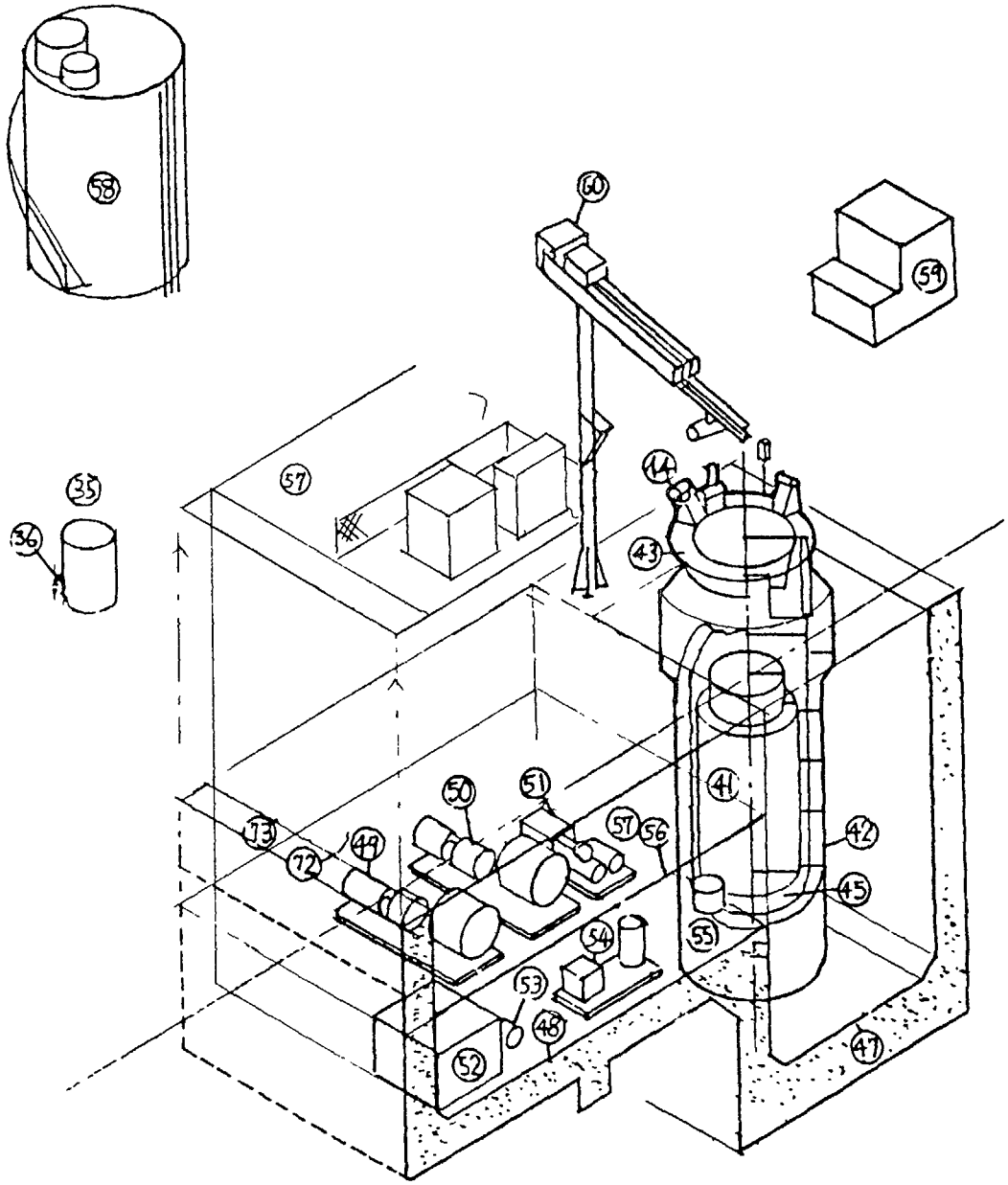


Figure 1-B HIGH PRESSURE TEST FACILITY

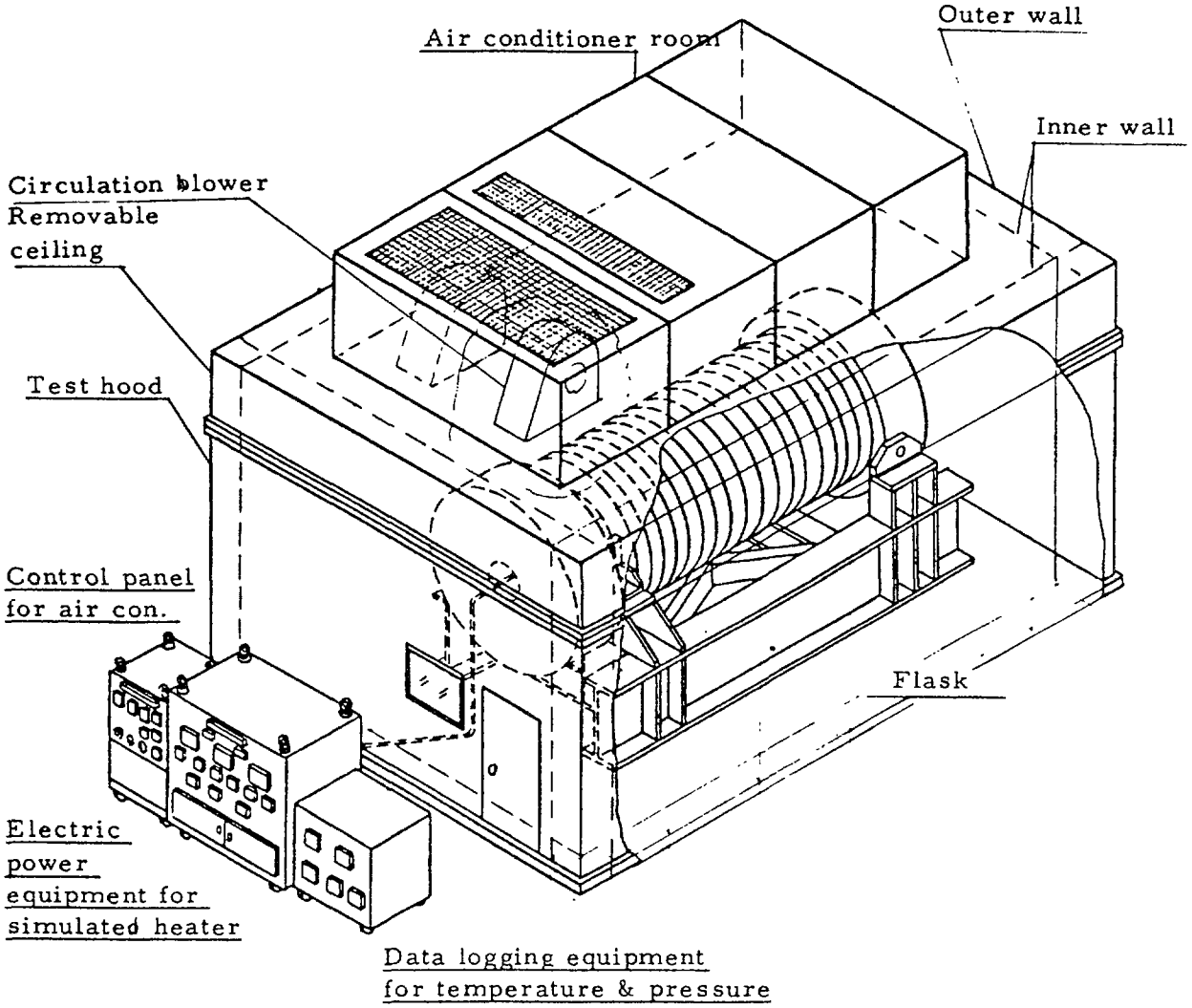


Figure 1-C Heat transmission test under constant condition

81. Flask
82. Fire test facility
83. Fire test furnace
84. Gas burner (Upper) 5 x 2
85. Gas burner (Lower) 5 x 2
86. Furnace peep hole
87. Removable stack
88. After burner
89. After burner
90. Sliding furnace door
91. Lift system of sliding furnace door
92. Truck for flask
93. Chain to move flask truck
94. Hood
95. Hood
96. Hood
97. Hood
98. Fan room
99. Control panel of F.T.F.
100. Data register panel of F.T.F.
101. Upper burner adjusting corridor
102. Lower burner adjusting corridor
103. LPG
104. Vapor riser
105. Hot water boiler
106. Bed for removable stack
107. Preparation space

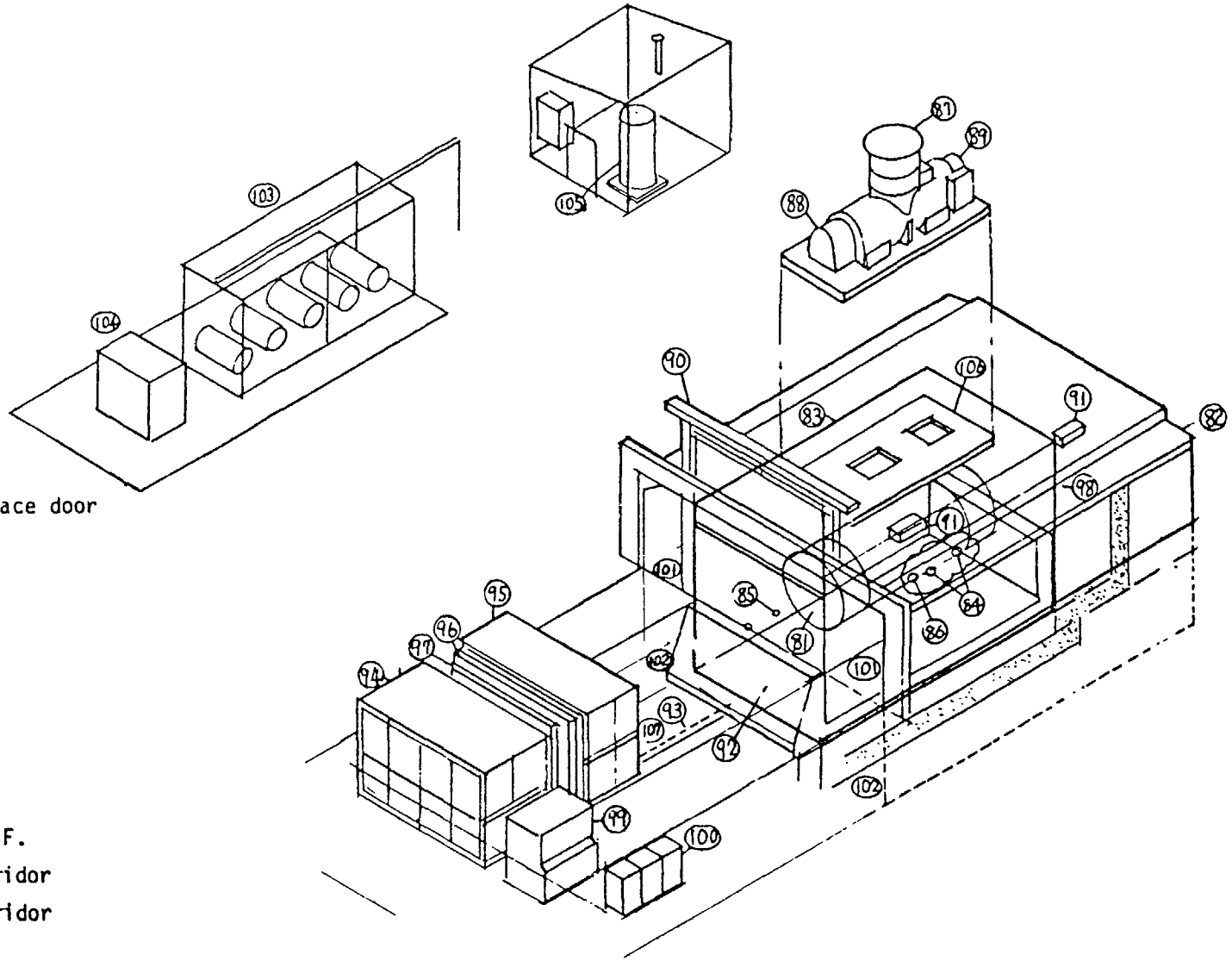


Figure 1-D FIRE TEST FACILITY

111. Flask
112. Shielding wall
113. Flask turning bed
114. Turning motor of flask turning bed
115. Flask upper collar
116. Shielding plate
117. Radiation source container
118. Lid of radiation source container
119. Radiation source
120. Driving system of radiation source
121. Shelter
122. Detector
123. Detector Driving Mechanism
124. Monitor camera
125. Control panel of S.T.F. (*)
126. Radiation source store
127. Control panel of flask turning bed
128. Control panel of driving system of radiation source
129. Control panel of driving system of detector
130. Data register panel of S.T.F. (*)

(*) 2F of Laboratory

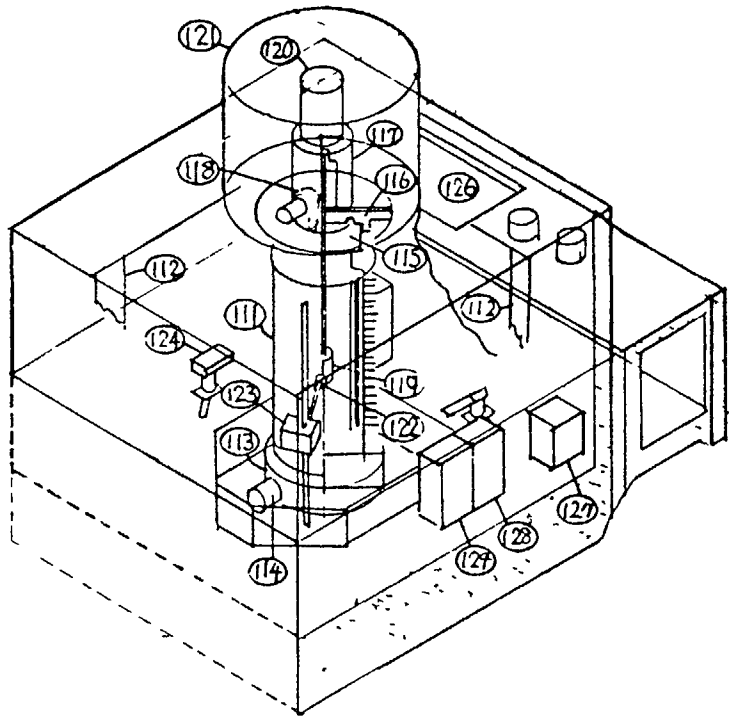


Figure 1-E Birds Eye View of Shielding Test Facility

POLAND

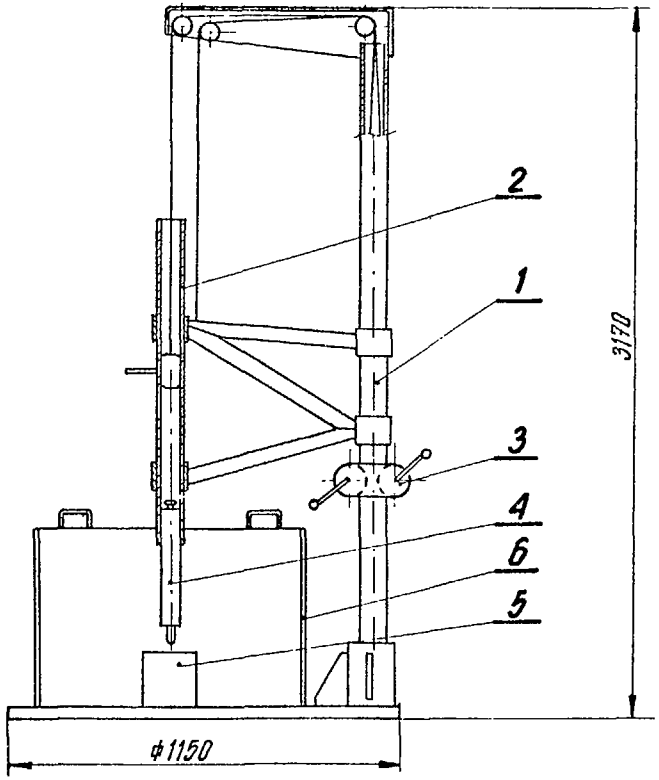
The following information is taken from the letter of the Resident Representative of Poland to the IAEA in his letter (313/82) dated 3 September 1982.

The Institute of Nuclear Research at Otwock-Swierk has the following stands for performing tests of packaging according to the requirements of the Agency's Regulations for the Safe Transport of Radioactive Materials:

1. Penetration test stand.
2. Water spray test stand.
3. Containment test stands (leakage test, shielding)

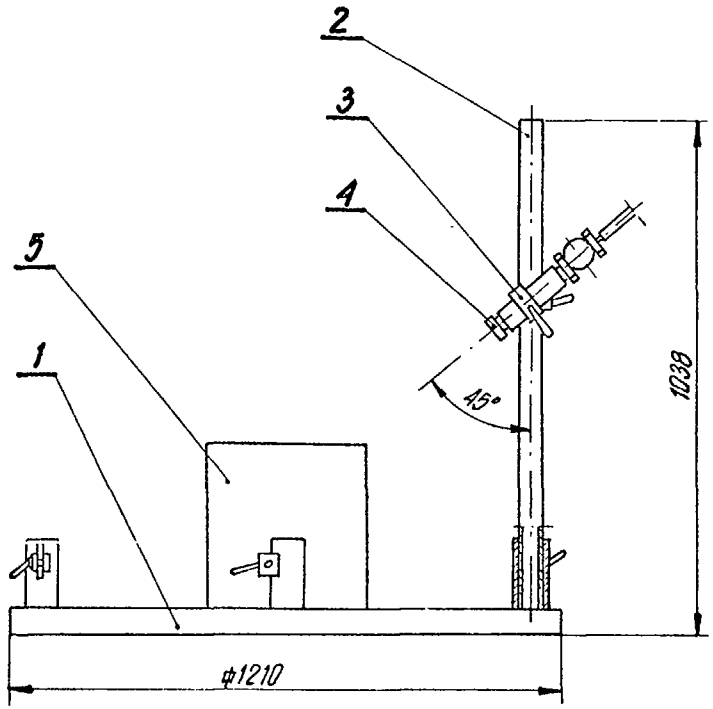
The particulars on the stands are in the following pages.

PENETRATION TEST STAND



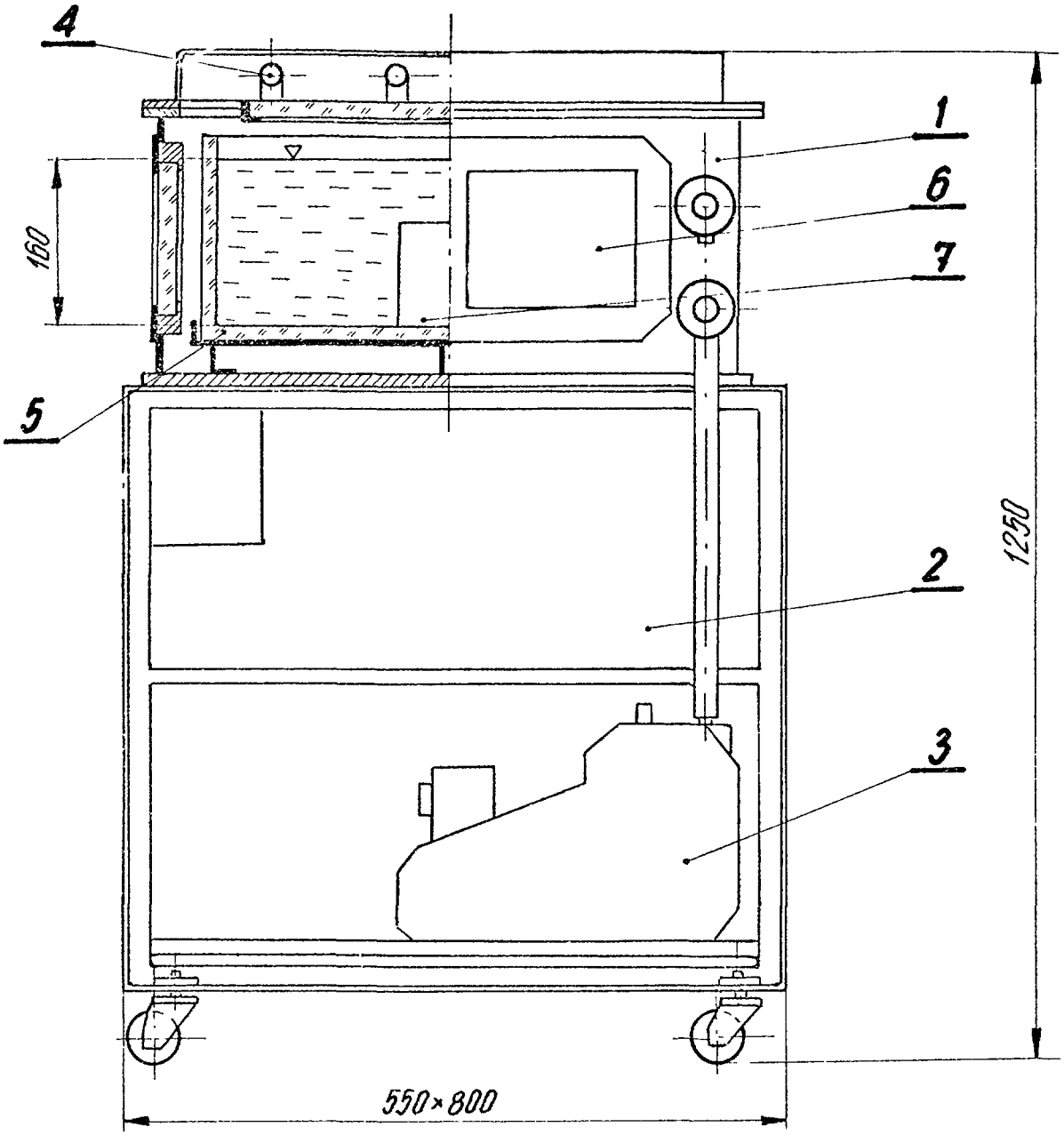
1. Column
2. Leading set
3. Lifting set
4. Bar, 6 kg. in weight and ϕ 32 mm in diameter
5. Tested packaging of 750 x 750 mm in overall dimensions
6. Shield

WATER SPRAY TEST STAND



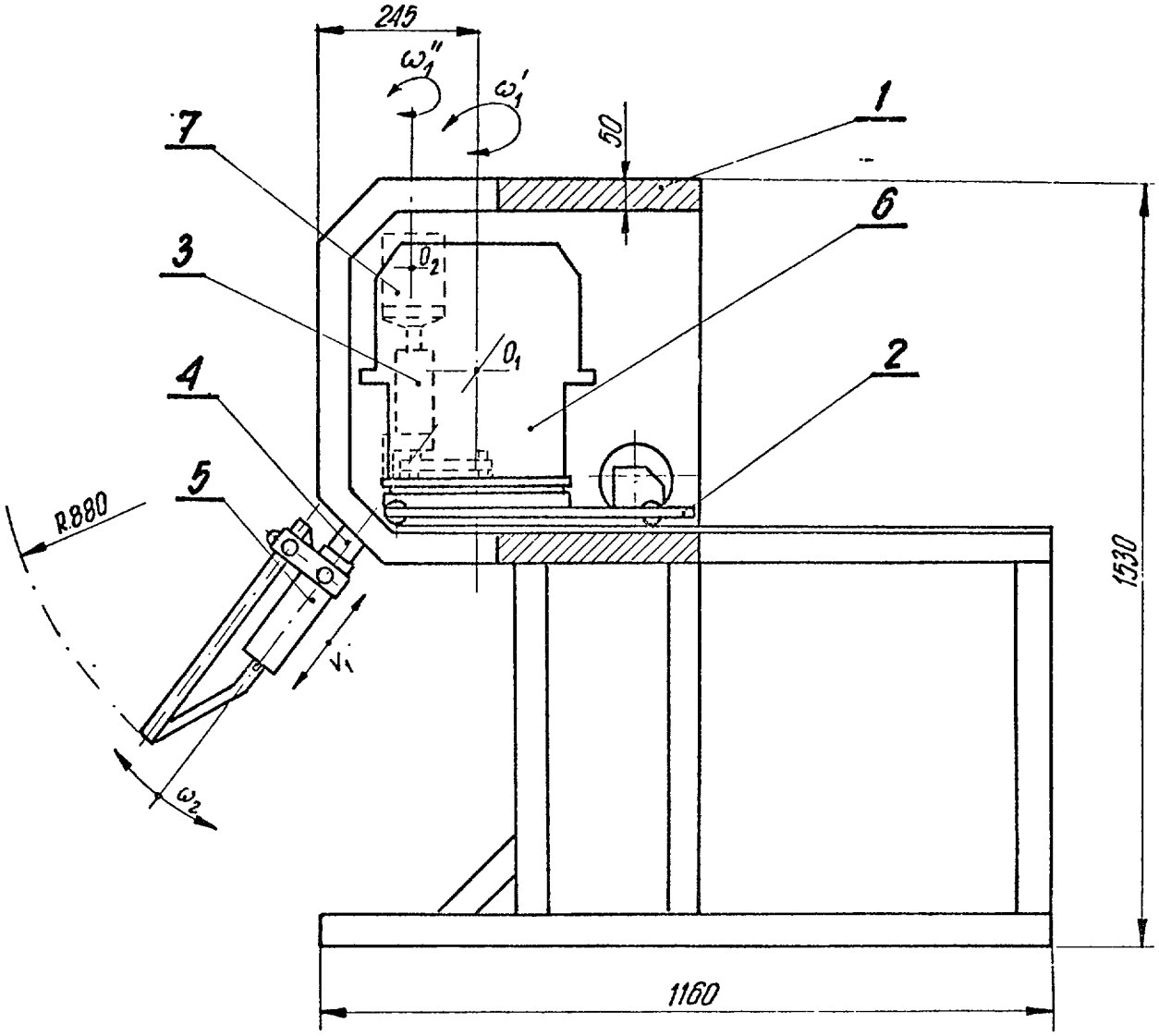
1. Base
2. Pole
3. Handle
4. Nozzle
5. Maximum overall dimensions of packaging are 750 x 750 x 750 mm.

CONTENT LEAKAGE TEST STAND



1. Vacuum chamber
2. Box on rails
3. Vacuum pump
4. Chamber lighting
5. Immersion tank with ethylene glycol
6. Sight - glasses
7. Tested containment system of maximum dimensions
   ∅ 200 x 130 mm.

RADIATION LEAKAGE TEST STAND (RADIOMETRIC METHOD)



1. Radiation shielding
2. Turntable trolley
3. Rotating attachment
4. Rotating arm
5. Measuring probe
6. Bigger tested container
7. Smaller tested container

O_1 - rotating arm axis with measuring probe for bigger containers (maximum dimensions Ø 300 x 350)

O_2 - rotating arm axis with measuring probe for smaller containers (maximum dimensions Ø 110 x 130)

ω'_1, ω''_2 - speed of containers rotation (electric drive)

ω_2 - speed of arm with probe rotation (hand operation)

V_1 - probe travel along arm (hand operation)

SWEDEN

The following information was received from the Permanent Mission of Sweden to the IAEA in its letter dated 29 September 1982.

There are no facilities available in Sweden where a complete set of tests could be performed. Available resources are limited to assessment of analyses or calculations aiming at demonstrating compliance with the applicable parts of the Regulations -- e.g. structural or stress analysis, heat transfer analysis and assessment of construction materials characteristics - as well as to assessment of radiological protection and criticality safe aspects of package designs.

Assessment and advice with regard to the calculations and material characteristics can be obtained from:

Swedish National Testing Institute
P. O. Box 857
S-501 15 Boras — Telex No. 362 52 TESTING
SWEDEN — Telephone No. (33) 16 50 00

Assessment and advice with regard to radiological protection and criticality safety aspects can be obtained from, respectively:

Swedish National Institute of Radiation Protection
P. O. Box 60 204
S-104 01 Stockholm — Telex No. 117 71 SAFERAD
SWEDEN — Telephone No. (8) 24 40 80

and

Swedish Nuclear Power Inspectorate
P. O. Box 27 106
S-102 52 Stockholm — Telex No. 119 21 SWEATOM
SWEDEN — Telephone No. (8) 63 55 60

Note: General questions about services should be addressed to the Swedish Nuclear Power Inspectorate, which will undertake to forward, as necessary, any detailed questions addressed to them, as well as to serve as a general focal point in these matters. Competent authority package design approval would be issued by one of the latter two organizations. In terms of financial implications the advice is to discuss them directly with the organization(s) involved.

SWITZERLAND

The following information was received from the Permanent Mission of Switzerland to the International Organizations in Vienna in its letter (068/82) dated 18 June 1982.

"Discussions between the Swiss authorities and the competent bodies have shown that in Switzerland there are in effect institutions in a position to perform the prescribed tests, for example the "Federal Materials Testing Laboratory" and the "Research Institute for Industry, Civil Engineering and Trades", whose experts possess the required technical expertise.

However, they have not yet had enough practical experience, and a certain amount of time would be needed to make preparations for the requisite tests.

In Switzerland the transport of radioactive materials has always been carried out in packagings tested abroad and there is not likely to be any need in the future to perform such tests within the country."

UNITED KINGDOM

The Department of Transport provided the following information in its letter (DGB 23/3/012) dated 27 August 1982:

"Three organizations in this country have such facilities: United Kingdom Atomic Energy Authority, the Central Electricity Generating Board and Amersham International plc. In addition to the information provided, Amersham International plc. hope, in the near future, to complete the construction of a 9 metre drop testing facility for packages up to 125 kg."

It is not possible to supply details of the financial implications as this would vary considerably depending on the type of package and the testing required.

TRANSPORT PACKAGING TEST INSTALLATION

Atomic Energy Research Establishment, Harwell.

I. IDENTIFICATION AND GENERAL INFORMATION

For the attention of Head Engineering Projects Division

Title and address of installation - Atomic Energy Research Establishment, Harwell, Oxfordshire, OX11 ORA

Date of establishment - Established in 1946

Operated by - The United Kingdom Atomic Energy Authority (a state corporation)

Number and type of staff employed -

General description of site and routes of access - Situated in South Oxfordshire on the edge of Berkshire Downs, 120 m. above sea level. It is approximately 80 kms. from London, 50 km. from London Airport (Heathrow), 25 km. South of Oxford, 1.5 km. to the West of trunk road A 34 and 10 km. from the main line railway station at Didcot, which is on the London to Bristol route.

II. DESCRIPTION OF FACILITIES AND SERVICES

(a) General description

AERE Harwell has test facilities and equipment available to carry out all of the Type A and Type B test requirements of the IAEA Regulations for the Safe Transport of Radioactive Materials and have been actively engaged in the testing of transport containers for UKAEA and commercial users since 1960.

Details are as follows:

(b) Type A tests

Water spray test	Equipment to simulate specified rainfall as required by IAEA regulations.
Impact test	3 tons at 9 m. drop on to a 30 ton target. Limited not by weight, but impact energy, e.g. capacity for 1 m. drop is 27 tons suspended from crane hook with a manually operated quick release hook with remote control. Attitude pre-set by adjustment of slings.
Compression test	Static load tests or compression test machine.
Penetration test	Penetration test rig designed to IAEA test standard.
Shielding integrity test	Use of standard radiation source and monitoring with photographic film at surface. Also radiation dosimetry tests using dose-rate meter.

Containment testing	Leakage testing by pressure isolation method. Internal and external pressure tests. Vacuum testing for rought, medium and high vacuum sensitivities.

(c) Type B tests

Mechanial tests

Impact test	3 tons at 9 m. on to a 30 ton target. Limited not by weight, but impact energy, e.g., capacity for 1 m. drop is 27 tons suspended from crane hook with a manually operated quick release hook with remote control. Attitude pre-set by adjustment of slings. Decelerations measured by mechanical go-no go accelerometers of pre-selected rating and by high speed cine cameras filming against a horizontal grid background. Scale model testing also carried out.
Punch test	6 inch diameter punch on a 30 ton base. Scaled punches for scale model testing.

Thermal tests

Furnace-oil fired 0 - 1000°C	1.1 x 1.2 1.1 m. 320 kg. (Timber charge) 700 kg. (Metal charge)
Open fire: oil fired	Any weight and size considered. Temperature of furnace and open fire tests monitored by thermocouples and recorded on charts to give time-temperature curves.

Water leak tests

Water in leakage test	Capacity for medium size containers. Immersion in water tank to a depth of at least 0.9 m.
Water immersion test	Immersion to a depth of at least 15 m. using hired facility. Capacity only limited by that of mobile crane hired.

Integrity

Shielding	Use of standard radiation source and monitoring with photographic film at surface. Also radiation dosimetry tests using dose-rate meter.
Containment testing	Leakage testing by pressure isolation method. Internal and external pressure tests. Vacuum testing for rough, medium and high vacuum sensitivities.

(d) Special form material tests

Capsule impact test	Facilities for testing to IAEA standards.
Capsule percussion test	Percussion test rig designed to IAEA standard.
Bending test	Testing to IAEA specification.
Heat test	Furnace tests to IAEA specification.
Leaching tests	
- indispensable solid material	Testing to IAEA specification.
- encapsulated material	Testing to IAEA specification.
Other integrity tests	Pressure tests: hydraulic and pneumatic - internal and external
	Vacuum tests
	Non-destructive tests: penetrant dye - radiography - ultrasonic tests

III. ADDITIONAL FACILITIES AND SERVICES

(a) Materials testing — Could be carried out.

(b) Low-temperature testing — Could be carried out.

(c) Vibration testing — Could be carried out.

(d) Other types of testing

The Transport Container Section has the expertise to carry out tests more stringent than at present demanded by Statutory Regulations and, for example, has carried out free fall drop tests on transport containers at 2000 feet from a helicopter, in collaboration with the Royal Air Force. The Section also has the back-up facilities offered by a large, well equipped Engineering Division in research, manufacture and inspection, as well as being able to call on the specialized facilities of the scientific Divisions.

Tests that can be carried out include:

Pressure tests :	hydraulic and pneumatic - internal and external
Vacuum tests	
Non-destructive tests:	penetrant dye - magnetic crack detection - radiography- ultrasonic tests.

IV. INTERNATIONAL AVAILABILITY OF SERVICES

Terms and conditions under which the services could be made available internationality:

The facilities could be offered as a complete service, i.e., staff and equipment, on normal commercial terms, for example, cost plus or fixed price.

Information required from applicants for services:

The information required would be a test specification, size, weight and number of test specimens, date at which they would be available for test, the required time scale for tests and report, presence of witnesses to tests from customer or independent approval authority, if special handling or lifting equipment is required and, if so, whether it would be supplied, supply of two complete sets of drawings, and a statement of the official language.

Channels of communication with the operators of the facility:

Letter, telephone, telex and personal contact.

Procedures for reporting and certifying results of tests:

A comprehensive test report would be prepared which could be submitted initially in draft form before final copy together with complete set of photographs and a cine film recorded at normal,and/or high speed as appropriate, as required.

TRANSPORT PACKAGE TEST FACILITIES AT THE UKAEA ATOMIC ENERGY ESTABLISHMENT, WINFRITH, DORSET

1 Facilities exist at Winfrith for all the tests referred to in Section III, and defined in Section VII, of the IAEA Regulations for the Safe Transport of Radioactive Materials 1973 revised edition (as amended). In addition a range of services is available to provide substantiating or complementary data for submission to Competent Authorities; the services include material testing, metrology, metallurgy and analytical studies.

2 Drop Tests

There are 3 drop test facilities. One is installed inside the Dragon Reactor building and is used for scale model tests. The maximum drop distance is 24 M and typical model weight is 200 kg (with suitable impact limiters).

A second facility is used for full scale prototype testing. It is situated in a nearby limestone quarry and, because the target is a natural limestone bedrock of considerable depth and area,there is no practical weight limitation.

The third facility is situated outside, adjacent to the Dragon Reactor building. It consists of a massive concrete target weighing approximately 500 tonnes. Maximum possible drop is approximately 40 M; drops from 22 M are currently being carried out.

High speed photography (10,000 fps max) is used to record impacts and accelerometers are used to confirm deceleration.

Pre- and post-drop leak tests are performed using helium mass spectrometry but less sensitive methods can be called for.

3 Type A Tests

Water spray
Free drop
Compression
Penetration
Shielding integrity
Containment integrity

All these tests can be carried out to the full requirements of the IAEA Regulations.

4 Type B Tests

Mechanical Tests

All the required mechanical tests can be carried out.

Thermal Tests

Thermal performances are assessed by calculative methods. Computer codes used have been accepted by the UK Competent Authorities. There are no open fire test facilities, however, furnace tests could be offered in certain applications.

Water Immersion Tests

All water test requirements can be arranged.

Integrity Tests

Shielding integrity can be ascertained by all well proven methods eg scanning, gamma radiography and ultrasonic detection..

5 Special Form Material Test

Impact
Percussion
Bending
Heat
Leaching

All these tests can be carried out to the full requirements of the IAEA Regulations.

6 Availability of Services

Services are offered to both UK and overseas companies.

Enquiries and further information on any of the facilities or in respect of special requirements should be made in the first instance to Dr S A Cottrell, Head of Technology Division, AEE Winfrith.

Where potential customers find descriptions of services and facilities are insufficient or indicate that a particular capacity is not available, they should contact Winfrith (Dr S A Cottrell) and further information will be given. Design and manufacturing capacity at Winfrith ensures that special rigs and test equipment can be readily made available.

TRANSPORT PACKAGING TEST INSTALLATION.

1. Identification and General Information.

Central Electricity Generating Board
Structural Test Centre
Chelm's Coombe
Cheddar
Somerset
England.

The Test Centre was established as a structural testing facility in 1966, and has also been carrying out impact testing since 1973.

STC is operated by the Central Electricity Generating Board, Transmission and Technical Services Division.

Staff at present comprises qualified engineers of various disciplines, i.e. mechanical design, electrical, electronics and instrumentation etc., and skilled industrial staff.

The facility is situated at Cheddar in a former limestone quarry and is accessible from the motorway system (M5, M4 via Bristol), major sea ports (Southampton, Avonmouth etc.) airports (12 miles from Bristol Airport) and British Rail (stations at Bristol and Weston-super-Mare.)

2. Description of Facilities and Services.

(a) The Test Centre is equipped to carry out type A and type B package tests by means of two major falling-specimen rigs, one with a maximum capacity of 5 tonnes and the other, at present, 8 tonnes, both with 40 metre drop height capacility. The latter rig, however, is flexible in design and could be extended up to 25 tonnes. Falling weight rigs are also available of up to 25 tonne capacity. Each rig is serviced by extensive dynamic instrumentation and various high speed cine cameras, and video recording systems.

(b) TYPE A TESTS.

Water spray test: Equipment is available and is set up to suit individual test components.

Free drop tests: Type A tests are carried out in the main test rig which has a target comprising a 150 mm thick steel plate 4.6m x 1.8m securely anchored to the bed rock by 8 pre-stressed bars via a mass of concrete. This produces an anvil of massive proportions.

A 5 tonne hoist is used to lift the specimen to the correct drop height and various forms of rigging are used to achieve the correct impact attitude.

Test specimens are released from an electrically operated quick-release mechanism which is initiated from a sequence controller.

Maximum drop height on this rig approximately 40 metre
Workshop facilities are adjacent to the rig.

Compression tests: Compression tests are carried out either in the main rig or on an adjacent structure test area.

Loading is achieved using deadweights, or by hydraulic jacks, depending on the magnitude of the total test load (maximum 100 tonnes).

Penetration test: The main test rig covers the requirements of the I.A.E.A. Regulations Section 7, Para 714.

Shielding and Containment integrity tests: Facilities are available on site, or locally within the CEGB, to cover additional tests as required after the main impact or compression tests.

(c) TYPE B TESTS.

Mechanical tests: 9 metre and 1 metre punch, drop test facility available as detailed above.

Maximum weight capacity:
Main test rig - 5 tonnes
Large capacity rig - at present 8 tonnes with design capacity up to 25 tonnes.

Maximum height capacity:
Main test rig - 40 metres.
Large capacity rig - design capability 40 metres.

Release mechanisms - electrically operated quick release devices of 5, 10, 25 tonne capacity.

Attitude control - individual rigging arrangement to suit test specimen. Guidance systems and/or flight control on small scale models developed as necessary.

Targets - main test rig - 150 mm steel plate. 4.6m x 1.8m securely anchored to bed rock by 8 pre-stressed bars via a mass of concrete - this produces an anvil of massive proportions.

Large capacity rig - 150mm steel plate 6m x 4m, secured to bed rock by pre-stressed anchors.

Deceleration and deformation measurements: 32 channels of dynamic recording instrumentation available with a range of transducers for deceleration, pressure, strain, deflection etc. All data recorded on FM or direct record tape recorders (typically 0-40kHz) and replayed via transient capture devices and active filters. Digital or analogue outputs available.

Standard metrology techniques available for pre and post analysis of test specimen.

	Hydraulic and Nitrogen gas pressure/leak testing facilities available.
Photographic recording of impacts:	Still photography: 6 x 4.5cm, 35mm or Polaroid cameras using black and white or colour film. Cine photography. High speed 16mm cine cameras (at present one at 2000 fps, two at 10,000 fps) with associated high intensity lighting and control equipment. Standard 16mm cine cameras also available for general test recording. Motion analyser, employed for analysis of high speed cine films.
Video recording:	VHS and 'U'Matic recording facilities are available.
Scale model testing:	1/16th to full-scale models acceptable within the maximum weight criteria.
Thermal tests:	No facilities available.
Water Immersion test:	No facilities available.
Integrity tests:	As for Type "A" tests.

(d) Special form material tests.

Impact/percussion tests. Two "falling weight" rigs are available of the following capacities.

1 to 10 tonnes - 10 metres maximum height.
10 to 25 tonnes - 25 metres maximum height.
Ancillary services, such as instrumentation photography etc., as for the drop test rigs.

Bending tests - These tests can be carried out using the Centre's range of servo controlled hydraulic loading rams - typical ram capacity 100 tonnes.

Leaching tests - No facilities available.

3. Additional facilities and Services.

(a)	Materials testing	On site: 20 tonne tensile testing machine with extensometer. Hardness tester. Off site: Support services are available locally within the CEGB for determination of other physical and chemical properties of materials.
(b)	Low-temperature testing.	Components can be tested to -80°c using solid CO_2.

(c) Vibration testing. Test facilities are available for vibration testing,up to 10Hz say, by means of the servo controlled hydraulic system.

(d) Other types of testing. Full scale structural tests can be carried out for test specimens up to 70 metres in height by 25 metres square at the base. 25 servo controlled load channels of up to 100 tonne capacity each are available.

A computer controlled data logging system complements this test facility.

4. International availability of Services.

All test facilities are available to international clients. Quotations can be made up on the supply of full test details with ancillary service requirements.

Enquiries should be sent to:-

The Manager
Structural Test Centre
Central Electricity Generating Board
Chelm's Coombe
Cheddar BS27 3JQ
Somerset
England

Telephone No: 0934 742781

Telex No: 449074

Confidential test reports are issued at the conclusion of a test series, with a certificate of all measurements as appropriate.

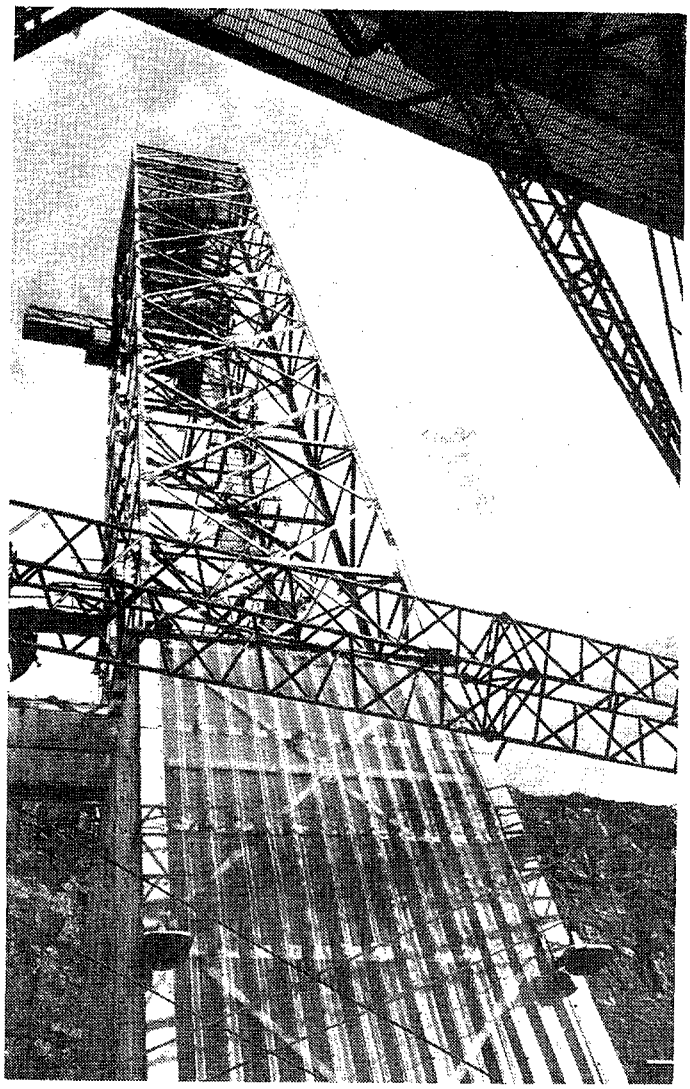
Impact Testing

The Test Centre is equipped with impact rigs of various specifications serviced by comprehensive shock measurement systems.

This form of testing requires that a test object is either dropped from a pre-determined height on to a target, or is impacted by a weight falling from a known height.

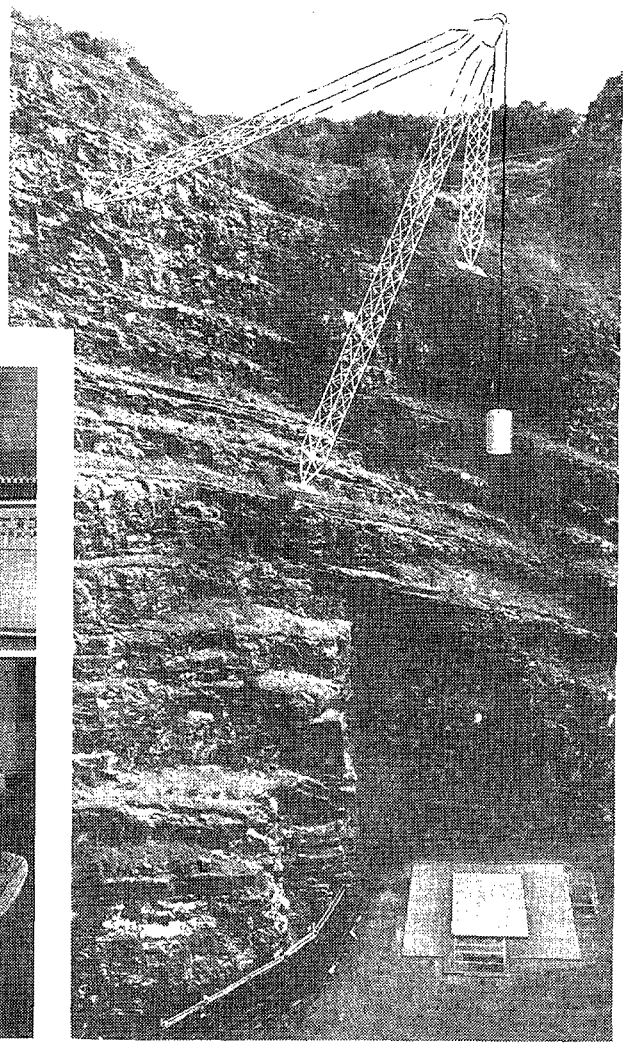
Test rigs have therefore been developed to cover these basic requirements with at present maximum parameters of 25 tonne weights and 40 metre drop heights.

Steel faced targets are securely anchored to the rock floor and are designed to be in excess of international impact test requirements.



▲1

▲2



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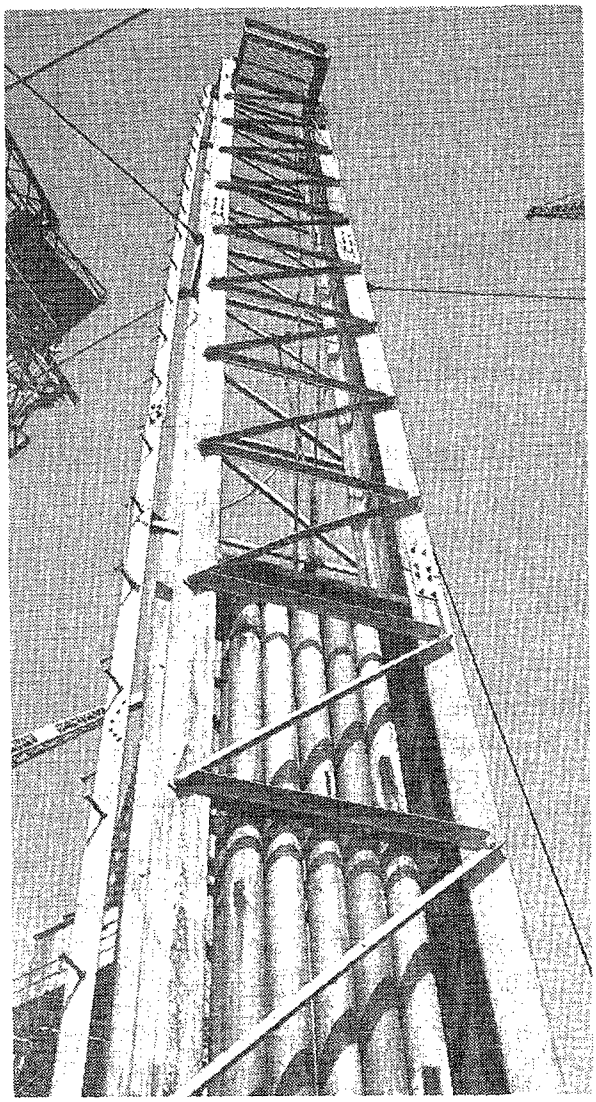

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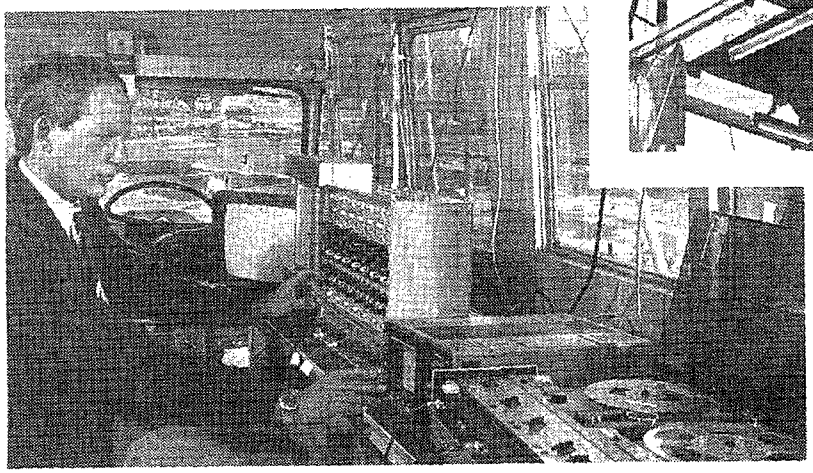

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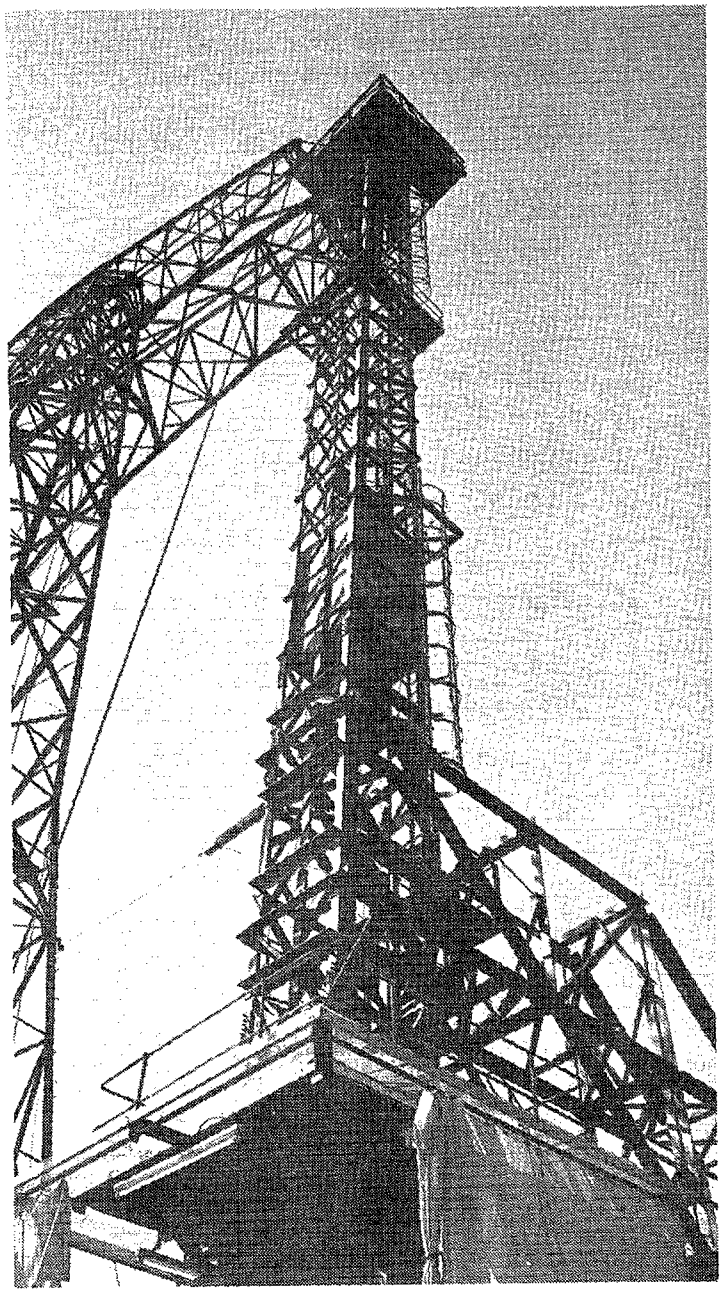


6 ▲

1. *5 tonne, 40 metre drop rig.*
2. *Control room.*
3. *25 tonne, 40 metre drop rig.*
4. *10 tonne, 10 metre drop rig.*
5. *Control/instrumentation service vehicle*
6. *25 tonne, 30 metre drop rig.*

AMERSHAM INTERNATIONAL LTD.
TRANSPORT PACKAGING TEST INSTALLATION

I. Identification and general information

Amersham International Ltd.
Amersham, Buckinghamshire, UK

Date facility established - 1972

Operated by:

Amersham International Ltd.- a leading manufacturer of radioactive materials and products.

Staff employed in facility:

Two technical assistants in a section headed by a qualified professional.

General description of site and routes of access:

10 miles north of London Airport (Heathrow). Near Chalfont-and-Latimer railway station.

II. Description of facilities and services

(a), (b), (c) - no entry

(d) Special form material tests

Facilities are available for carrying out all tests specified in IAEA Safety Series No. 6 (1973), Sections 726-737, and in ISO 2919 (1980). These tests can be carried out on inactive sources or on sources containing small amounts of radioactivity (e.r. 1 Ci Am241, 50 mCi Sr90, 10 mCi Co60).

The tests:-

Impact tests - weights of up to 20 kg can be dropped onto sources from heights up to 3 m, in a sealed enclosure.

Percussion test - the standard IAEA test of dropping a 1.4 kg weight onto a source resting on a soft lead anvil, in a sealed enclosure.

Bending test - rarely performed but can be done.

Heat test - muffle furnaces capable of temperatures up to 1200°C are available - one is situated in a sealed enclosure used for testing of active sources.

External pressure tests - sources can be subjected to external pressures of up to 170 MPa (25,000 psi).

Leaching tests - these standard tests are carried out daily on large number of sources. The levels of activity are measured by liquid scintillation counting.

Other tests include the ISO puncture test, low temperature testing, vibration testing, and most standard leak tests.

III. International availability of services

To be agreed at the time of an enquiry.

UNITED STATES OF AMERICA

The U. S. Mission to the International Atomic Energy Agency provided the following information in its letter dated 12 October 1982.

U.S. Radioactive Material Package Certification Test Facilities:

Organization	Type A Package Testing	Type B Package Testing Capability			
		Impact	Puncture	Thermal	Immersion
Monsanto-Mound Laboratory	X				
Oak Ridge National Laboratory	X	X	X		X
Sandia National Laboratory	X	X	X	X	X
Nuclear Packaging, Inc.	X	X	X		X
Southwest Research Institute	X	X	X	X	X
Stearns-Roger Manufacturing	X				X
Factory Mutual Research Center				X	

Attachment A: U. S. Department of Energy Facilities

Department of Energy Facilities with
Packaging Certification test Experience

- Sandia National Laboratories
- Oak Ridge National Laboratory
- Monsanto Mound Laboratory

Sandia National Laboratories
Environmental Testing Capabilities

Acceleration
(Centrifuges)

Climatic
(Ovens; Temperature, Altitude, Humidity, & Salt-Fog Chambers)

Shock
(Shock Macines, Actuators, Guns, Sled Tracks, Drop Towers, Cable Facilities)

Impulse Testing
(Explosive Loading, Flyer Plates)

Static Loading
(Testing Machines, Load Programmers, Static Jigs, Pressure Vessels)

Vibration
(Complex-Wave Facility, Shake Tables, Thruster Units)

Explosive Testing
(Explosion Chambers, Aerial Cable)

Reentry Simulation
(Radiant Heat, Arc Tunnel, Rain Erosion)

Electromagnetic Environments
(EMR, EMP, RFI)

Underwater Testing
(Water Tunnel, Water Impact, Water Immersion)

Fire Testing
(Enclosed and Open Jet Fuel Fires)

Sandia National Laboratories Facilities

Facility Title: Coyote Aerial Cable Facility

Test Category: Impact, Puncture, Dynamic crush

Brief Description: The Coyote Aerial Cable Facility is formed by steel cables that are stretched between two mountain peaks. Packagings are suspended from the cable and are either free-dropped or pulled-down with rocket assistance onto the desired target. Two steel-faced unyielding targets (each with a mass of 225 tonnes) and a variety of puncture spikes are available. For dynamic crush tests, a 500 kg. mass can be dropped onto the packaging.

Test Capability and Conditions: The maximum free drop height or pull-down velocity that can be achieved is dependent on the packaging mass. Examples are as follows:

Packaging Mass (kg)	Max. Drop Height (m)	Max. Pull-down Velocity (m/s)
5700	15	-
4500	30	-
2250	58	-
650	58	140
250	58	190

In addition, movable cranes can be positioned above the target area for 9 meter free-drops of packagings up to 20 tonnes. Temperature pre-condition is possible.

Instrumentations: Acceleration and strain data
Photometric coverage
X-ray imaging
36 data channels normally available, more on request.

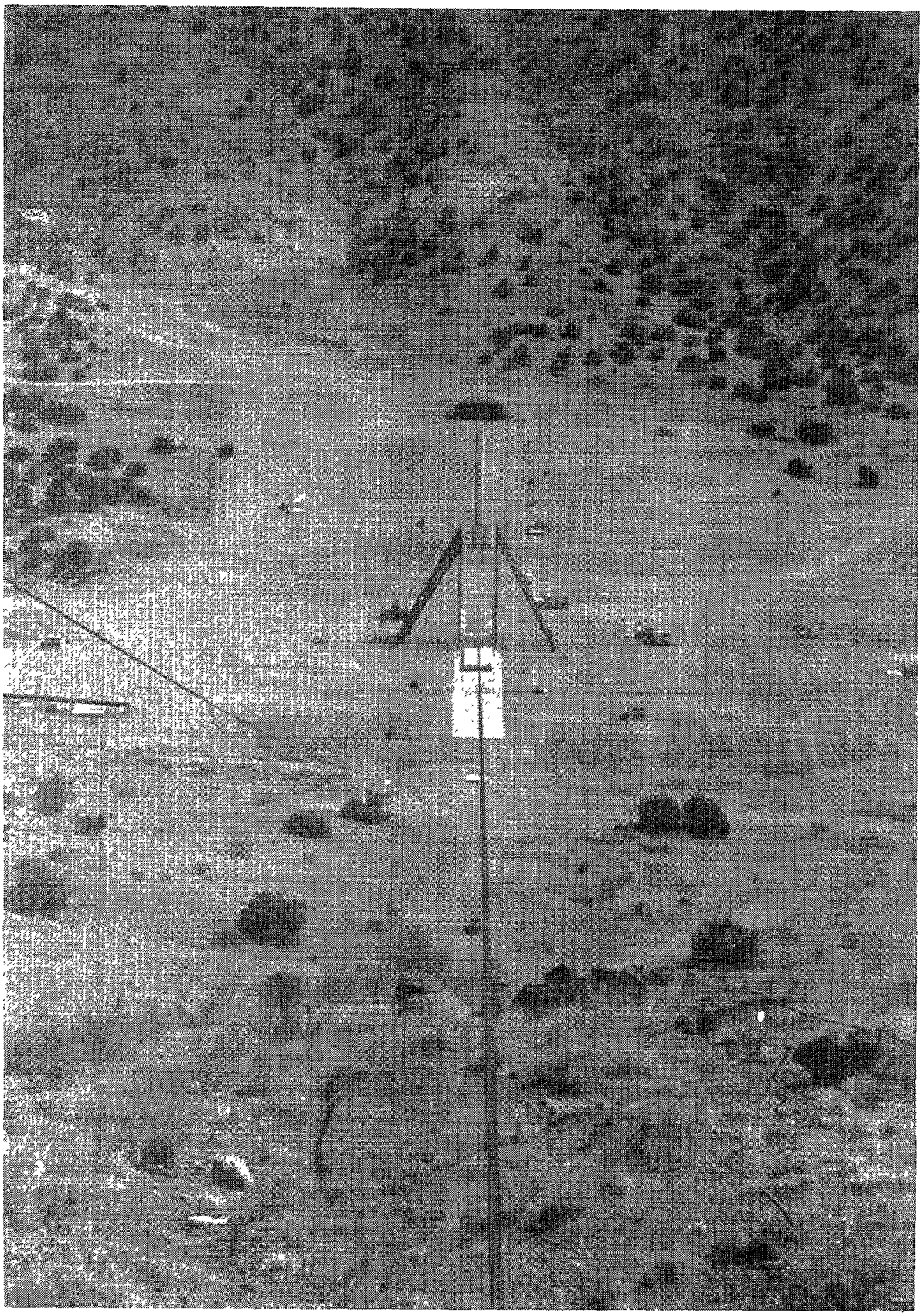
Cost Range per Test (US $): Cable free-drop: $5,000 to $40,000
Cable with rocket accelerated pull-down $10,000 to $50,000

Movable crane free drop $15,000 to $50,000

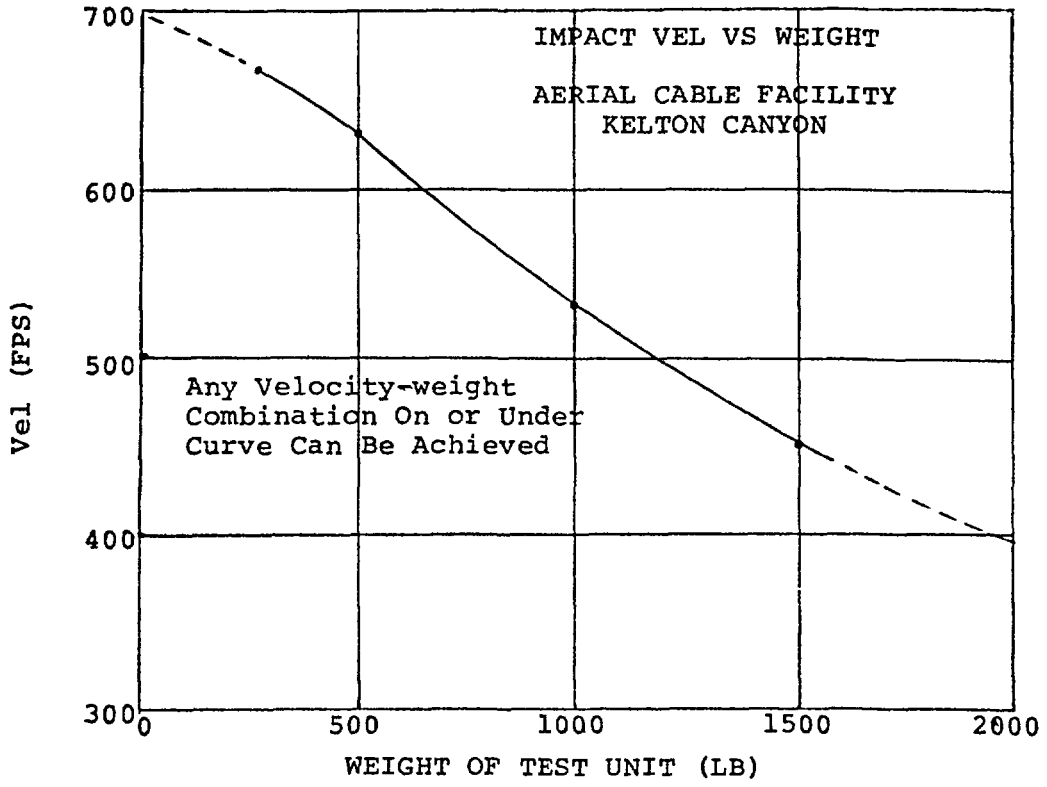
SNL Contact: Test Facility: D.C. Bickel
Division 7535, Sandia National Laboratories
P.O.Box 5800, Albuquerque, NM 87185 (505)- 844-1972.

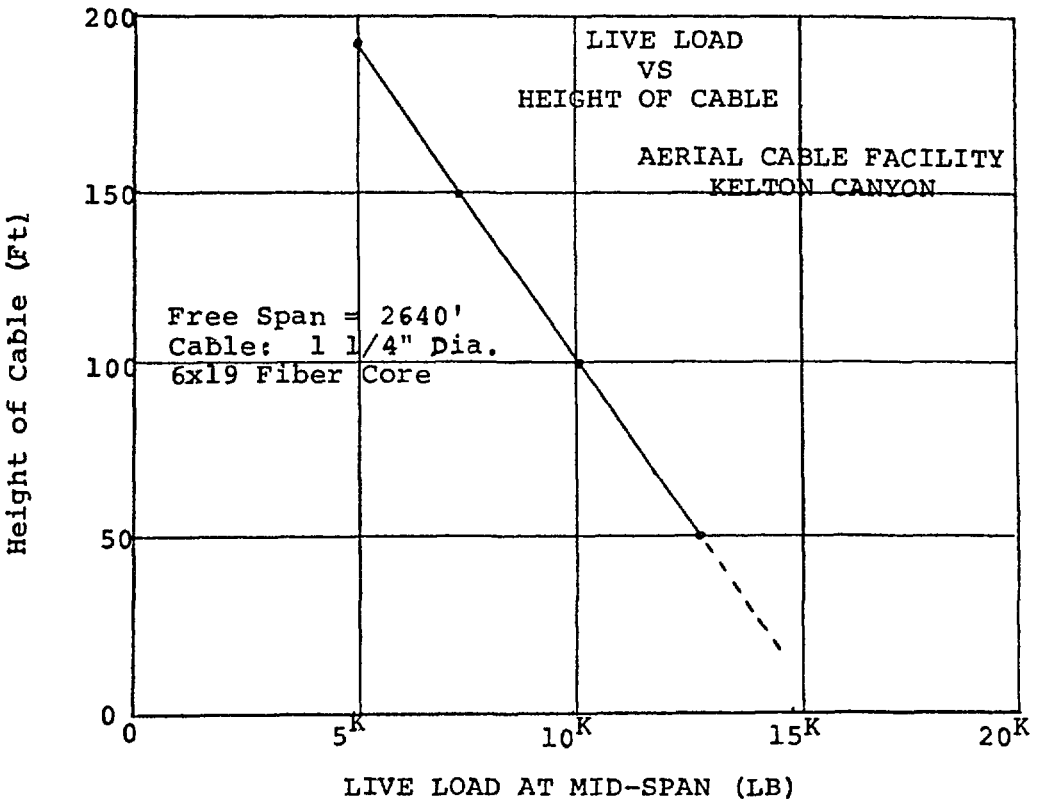
Transportation System Testing: W. C. Allen
Division 9783, Sandia National Laboratories
P.O.Box 9783, Albuquerque, NM. 87185, (505)844-6577

Coyote Aerial Cable Facility
(Kelton Canyon)



Facilities Aerial Cable Facility Capabilities





Sandia National Laboratories Facilities

Facility Title: New Rocket Sled Track

Test Category: Impact

Brief Description: The New Sled Track is approximately 1500 m long has a 0.56 rail gauge. The track can either be used as a mono or dual rail facility. Different targets can be constructed at the end of the track. To date, the facility has been used to test a variety of scale model transport systems.

Test Capability and Conditions: Packagings and transport systems are accelerated horizontally using a rocket sled. Maximum velocity is dependent on the mass and shape of the packaging. Normal transportation velocities are easily attainable for system models. Peak velocities of greater than 1500 m/s have been achieved at the facility. Temperature pre-conditioning of test units is possible.

Instrumentations: Acceleration, velocity and strain data.

Tracking and photometric coverage.
6 to 12 channels of telemetry data.
70 hard-wire data channels normally available, more on request.

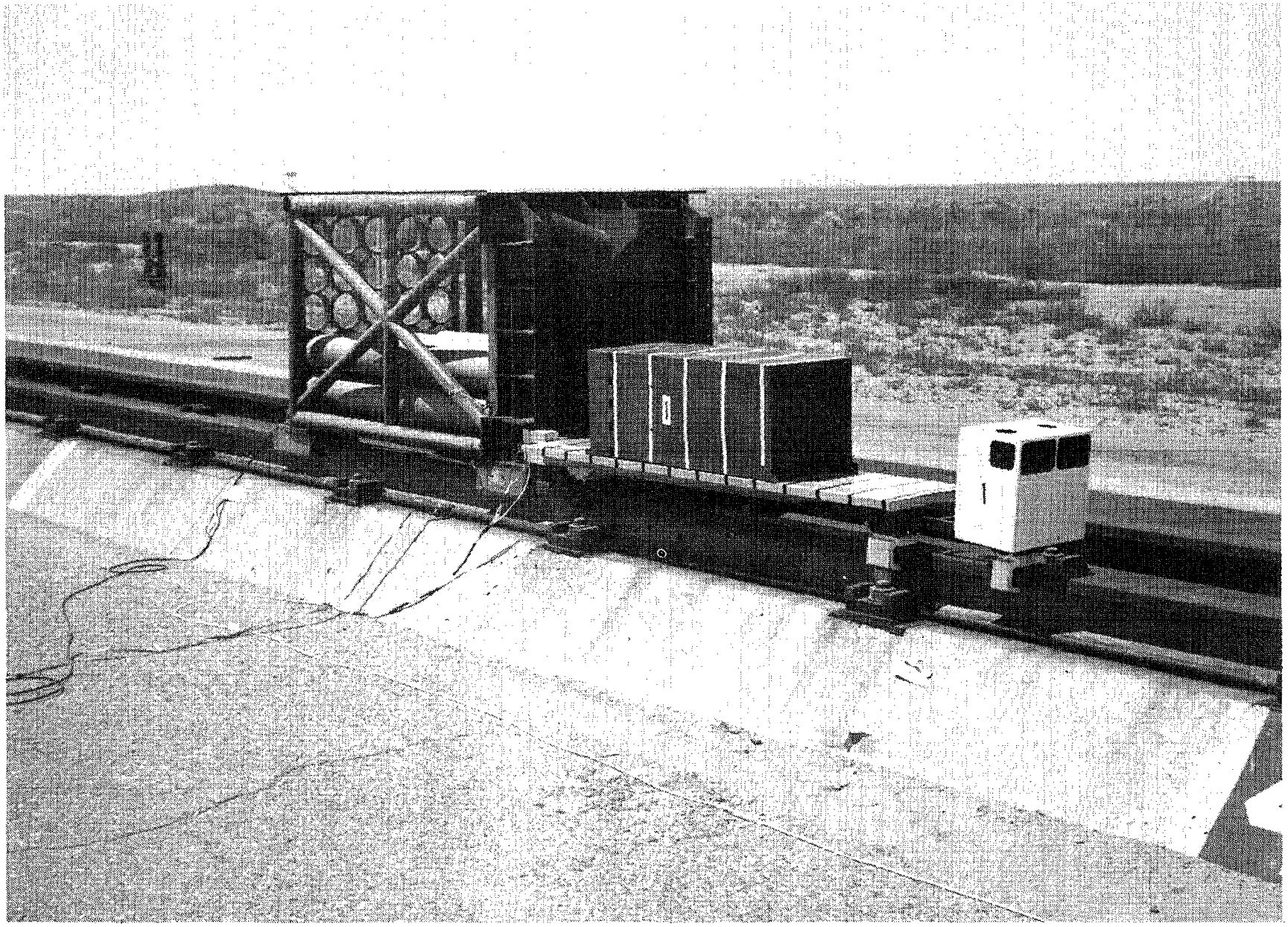
Cost Range per Test (US $):

$10,000 to $50,000

SNL Contact: Test Facility: D.C. Bickel

Transportation System Testing: G.C . Allen

New Rocket Sled Track



Sandia National Laboratories Facilities

Facility Title: Old Rocket Sled Track

Test Category: Impact

Brief Description: The Old Sled Track is approximately 500 m. long and has a standard U.S. rail gauge (1.43 m). This facility is used for full scale transport system impact tests. A simulated bridge abutment (1250 tonne) has been built across one end of the track and a large concrete fixture designed to react 4.6×10^7 kg. has been erected at the other end.

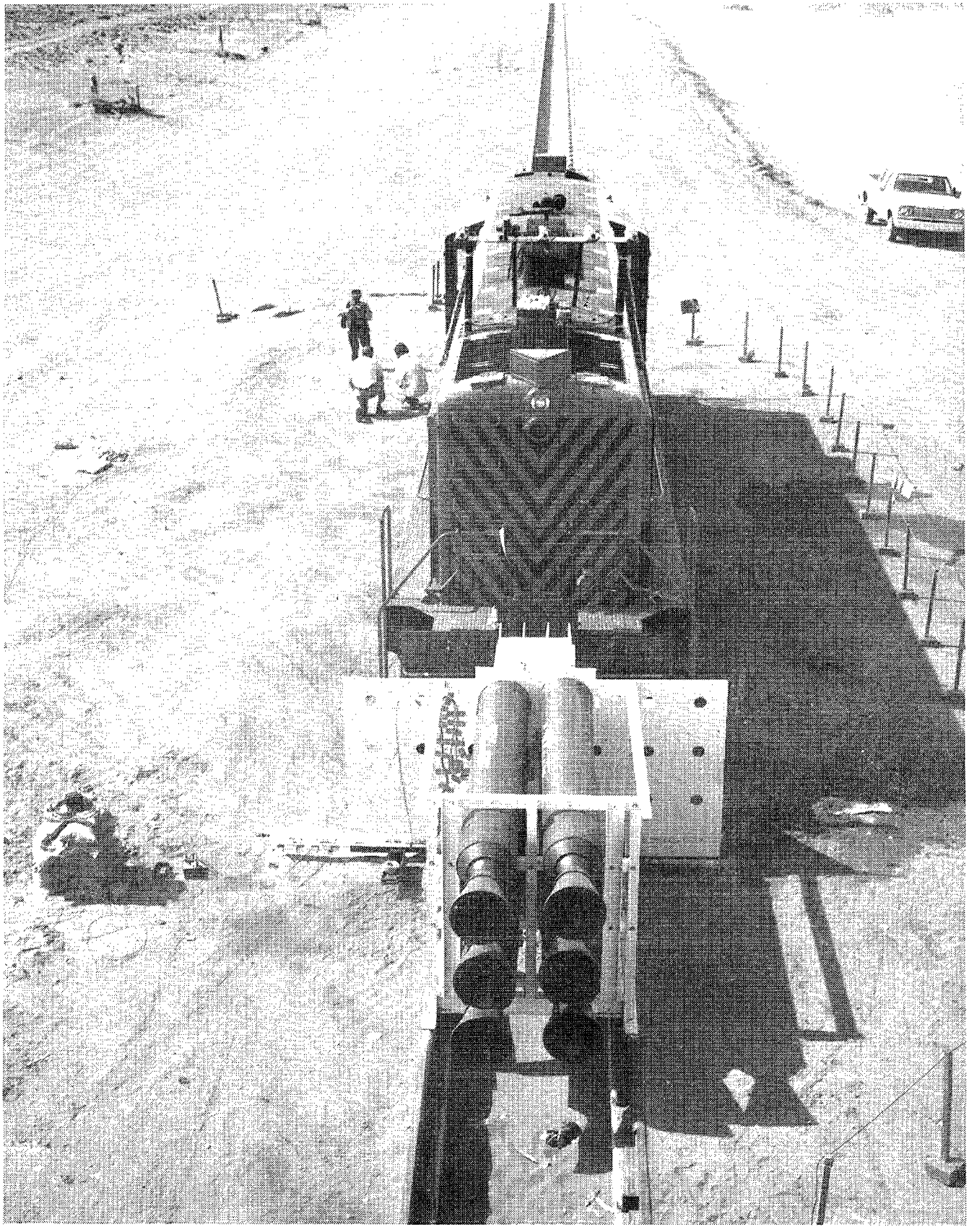
Test Capability and Conditions: Transport systems are accelerated horizontally using a rocket pusher sled. Transportation system velocities of less than 40 m/s are attainable. Temperature preconditioning of packagings is possible.

Instrumentations:
- Acceleration, velocity and strain data.
- Photometric coverage.
- 6 to 12 channels of telemetry data.
- 70 hardwire data channels normally available, more on request.

Cost Range per Test (US $): $100,000 to $200,000

SNL Contact: Test Facility: D. C. Bickel
Transportation System:Testing: G. C. Allen

Old Rocket Sled Track



Sandia National Laboratories Facilities

Facility Title: Chimney Burner

Test Category: Thermal

Brief Description: The Chimney burner is an enclosed JP-4 fuel fire facility. A 3 m pool is enclosed in a 4.9 meter diameter by 7.3 m high chimney. Air enters from beneath the facility through pipes dispersed in the pool. Air inflow is controllable and the fire normally operates in an air starved mode.

Test Capability and Conditions: Test objects up to a 1.5 m cube with a mass of up to 2000 kg may be tested to the following conditions:

Temperature: controllable within ± 30°C to any temperature in the range 790°C to 1200°C. Temperature is uniformally distributed within ± 85°C 1-6m above pool.

Heat flux: 90 kw/m^2 at 870°C 1 meter above pool.

Transients: 3 minute rise time 3 minute shut down.

Fuel consumption: 0.4 liters/s of JP-4 fuel.

Maximum fire duration: 4 hours.

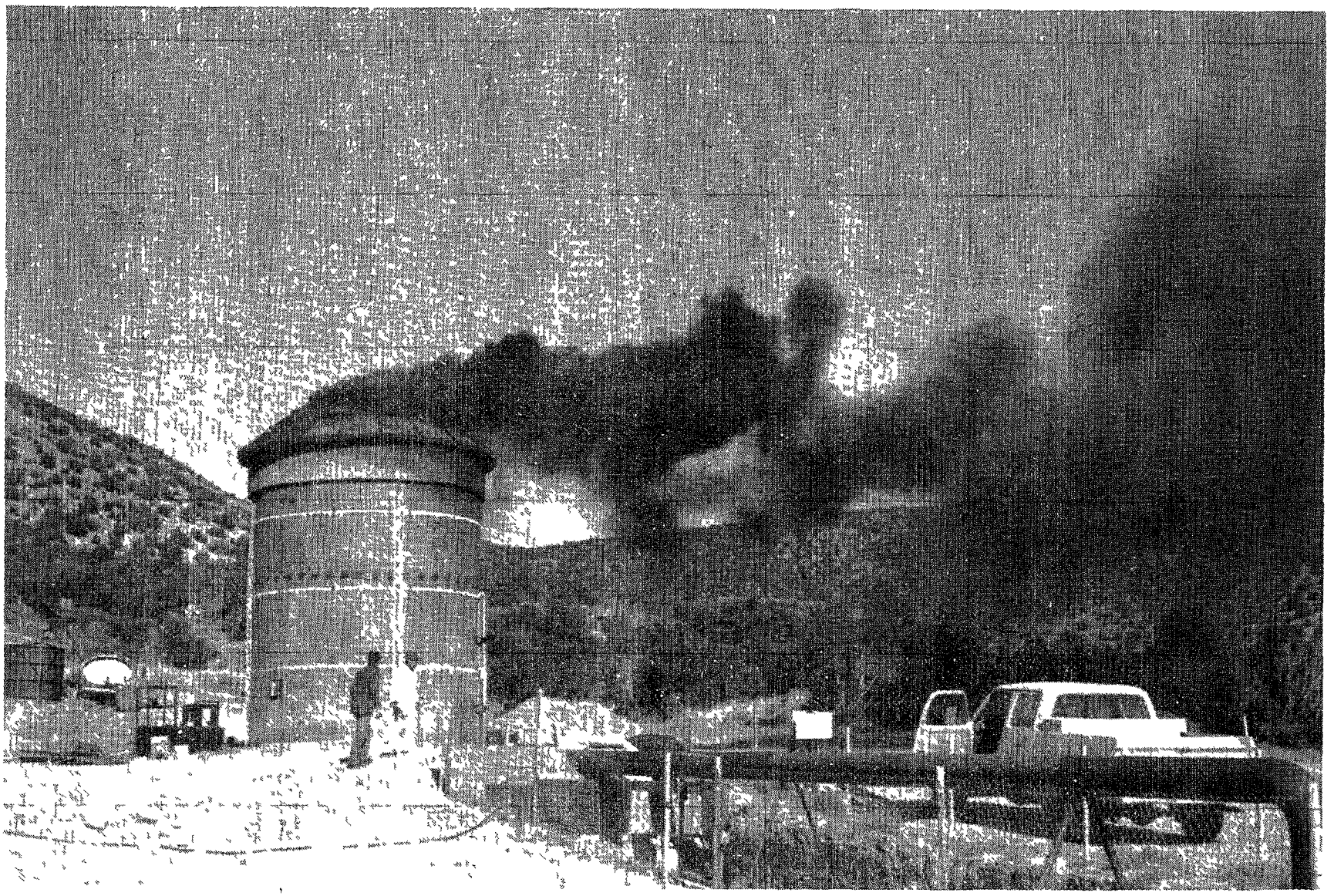
Instrumentations: Pressure, temperature and voltage data.
Video coverage and X-ray imaging.
120 digital data channels.
20 analog channels.

Cost Range per Test (US $): $5,000 to $50,000

SNL Contact: Test Facility: F.N. Mathews
Division 7533, Sandia National Laboratories
P.O.Box 5800, Albuquerque, NM 87185, (505)844-6129

Transportation System Testing: G.C. Allen

Chimney Burner Facility



Sandia National Laboratories Facilities

Facility Title: Open Pool Burner

Test Category: Thermal

Brief Description: The Open Pool Burner is a 9 m x 18 m rectangular pool for performing free burning JP-4 fuel fires. A layer of fuel is floated on top of a water-filled pool. Fuel is resupplied through piping underwater. No wind protection exists, but facility is located in a protected valley.

Test Capability and Conditions: Test objects up to 3m x 3m x 12m with a mass of up to 135 tonnes may be supported at heights up to a few meters above the pool surface and tested to the following conditions:

Temperature: Not controlled, uses an open jet fuel fire with unpredictable 3-dimensional and time variations because of wind effects. Temp. observed 540°C to 1300°C.

Heat flux: 170 kw/m^2 at 0.6 m and 1.2m above pool surface.

Transients: 1 minute rise time, 10 minute shutdown

Fuel consumption: 25 liters/s.

Maximum fire duration: 2 hours

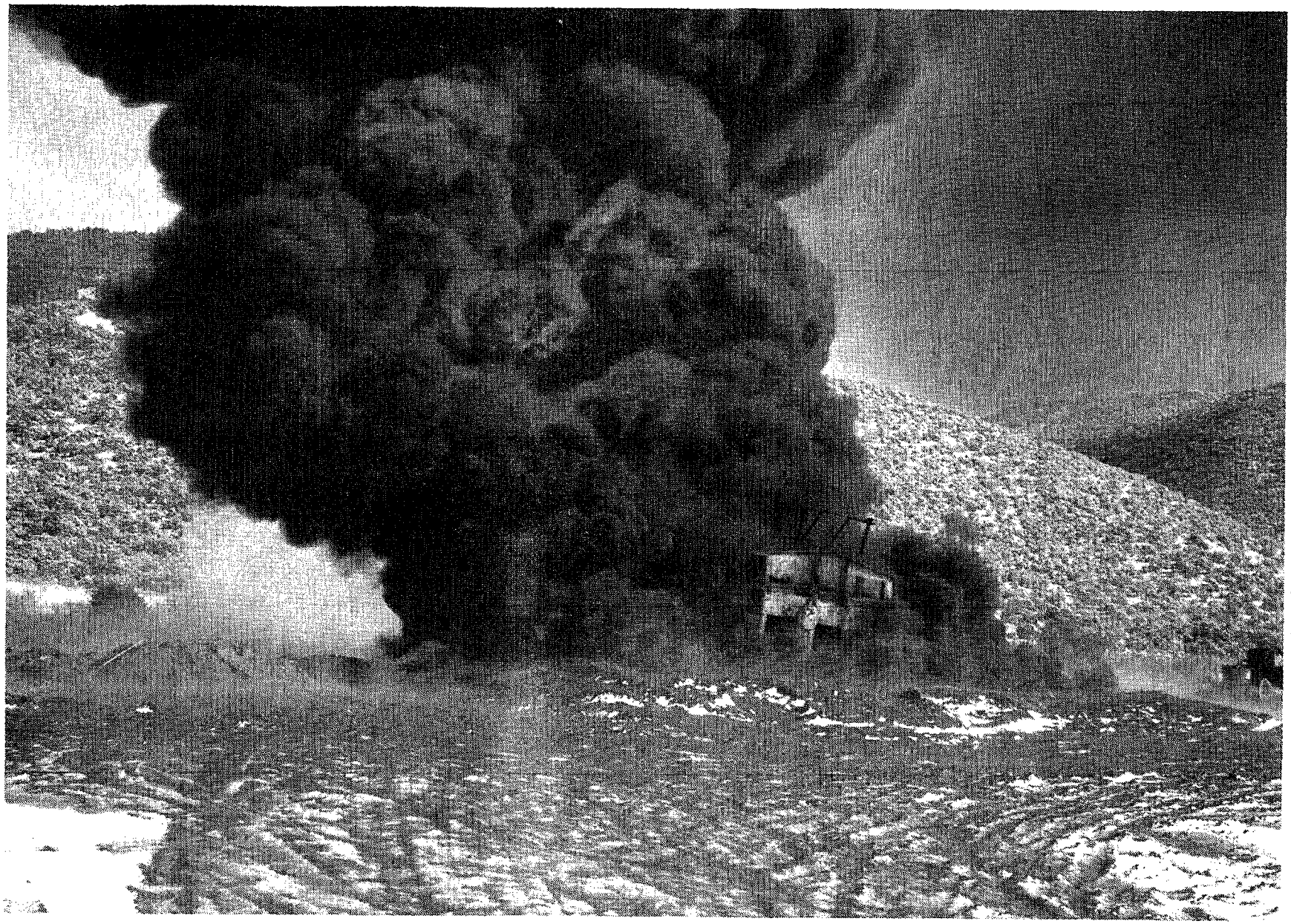
Instrumentations:

- Pressure, temperature and voltage data
- Infrared scanning and photography.
- 120 digital data channels.
- 20 analog channels.

Cost Range per Test (US $): $30,000 to $100,000

SNL Contact: Test Facility: F. N. Mathews.
Transportation System Testing: G.C. Allen

Open Pool Burner



Sandia National Laboratories Facilities

Facility Title: Large Fire Test Facility

Test Category: Thermal

Brief Description: The large fire test facility (LFTF) is an enclosure for a fire burning JP-4 fuel fire. The enclosure is 18 m wide, 27 m long, and 6 m high and surrounds a pool, 9 m by 18 m. The enclosure provides an effective wind barrier to allow repeatable fire tests. (Note: The LFTF is undergoing final design and construction as of 8/31/82).

Test Capability and Conditions: Test objects up to 3m x 3m x 12m with a mass up to 135 tonnes may be supported at heights of a few meters above the pool surface and tested to the following conditions:

Temperatures: Temperature will be representative of a JP-4 fuel fire with no wind disturbance in the test area. This provides a predictable and repeatable 3-dimensional temperature distribution with minimal time variation.

Heat flux: 170 kw/m^2 at 0.6 m and 1.2 m above pool surface.

Transients: 1 minute rise time, 10 minute shutdown.

Fuel consumption: 25 liters/s.

Maximum fire duration: 2 hours.

Instrumentations:

- Pressure, temperature and voltage data.
- Video coverage.
- 120 digital channels.
- 20 analog channels.

Cost Range per Test (US $): $30,000 to $100,000

SNL Contact: Test Facility: F. N. Mathews
Transportation System Testing: G.C. Allen

Sandia National Laboratories Facilities

Facility Title: Drop Tower Lake

Test Category: Water Immersion

Brief Description: The Drop Tower Lake is a lined, trapezoidal-shaped freshwater pool. The pool surface is 36 m by 47 m. The bottom of the pool is at a depth of 15.2 m and is 6 m by 9 m. In addition, a 1.3 m diameter pipe extends an additional 9 m (to a total depth of 24 m) below the bottom of the concrete pool. (Note: Drop Tower Lake is scheduled for completion in the fall of 1982).

Test Capability and Conditions: A variety of packagings can be immersion tested at depths up to 15 m (24 m for packaging less than 1.2 m in diameter).

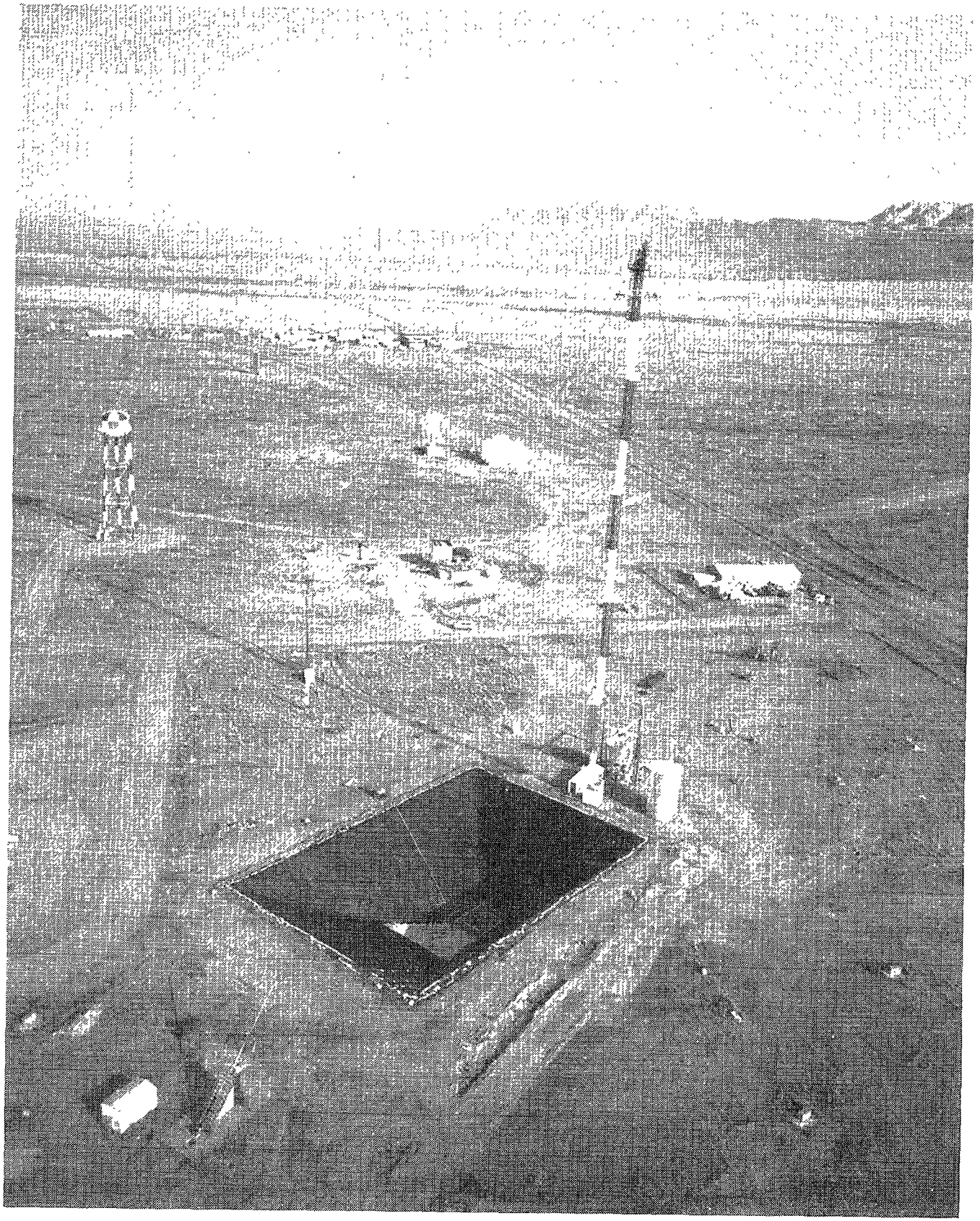
Instrumentations:

- Temperature, pressure, and strain data.
- 70 hardwire data channels normally available, more on request.
- Leakage measurements.

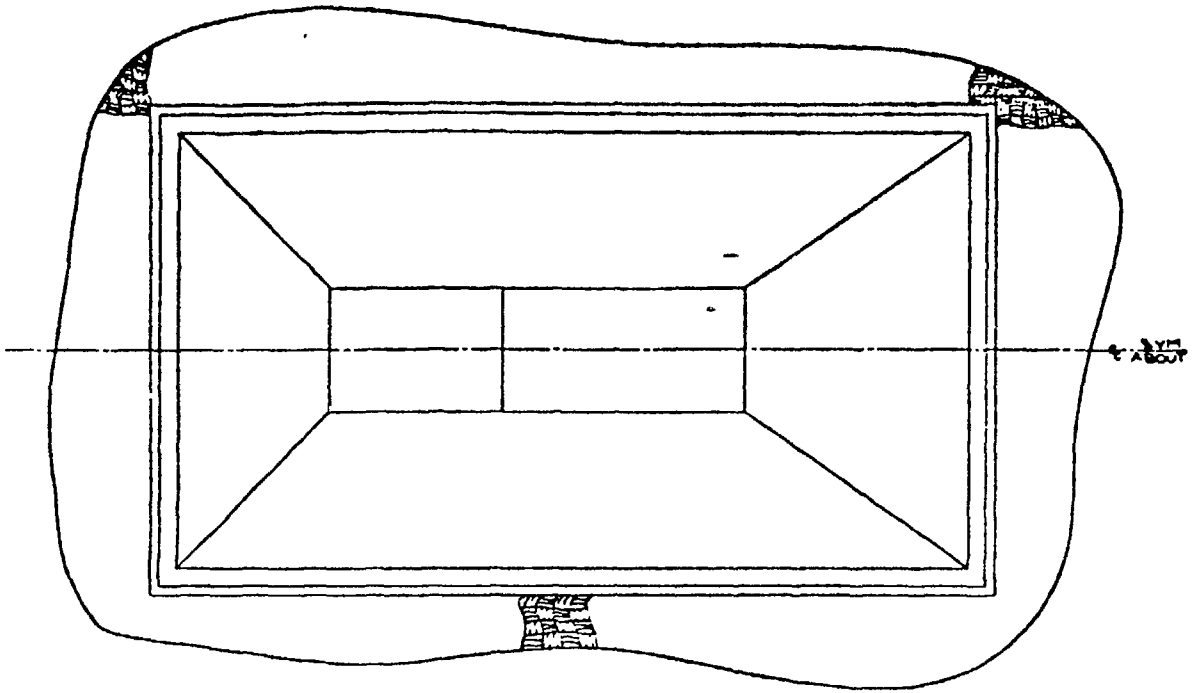
Cost Range per Test (US $): $2,500 to $25,000

SNL Contact: Test Facility: D.C. Bickel
Transportation System Testing: G.C. Allen

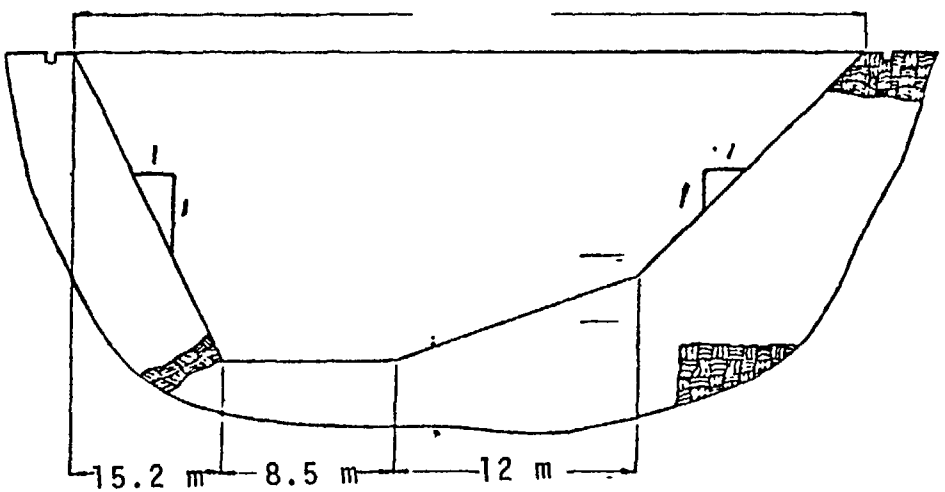
Drop Tower Lake

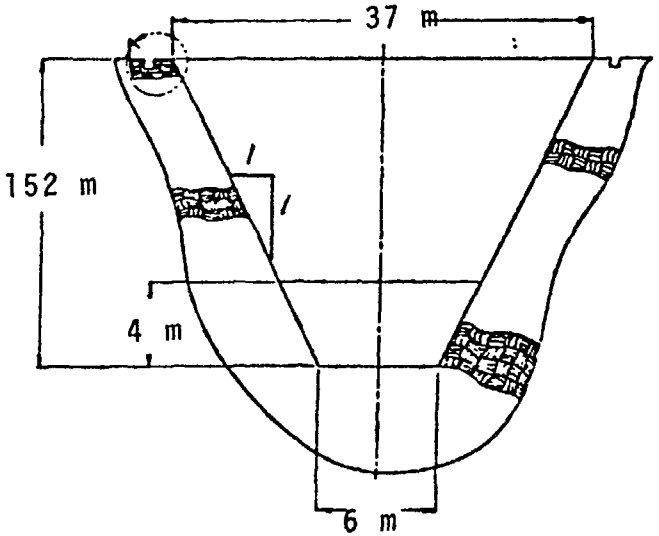


Drop Tower Lake



47 m





Oak Ridge National Laboratory
Packaging Test Capability

Oak Ridge National Laboratories Facility for Performing
Radioactive Material Packaging Certification Tests

Facility Title	Test Category	Brief Description and Test Capabilities	Instrumentation	Cost Range Per Test	Contact
Tower Shielding Facility	Impact, Puncture, Dynamic Crush	A large drop test-facility was constructed at the Tower Shielding Facility (TSF) at the Oak Ridge National Laboratory. A 670-metric ton impact pad was constructed of reinforced concrete and armor plate and located between two 96-m-tall towers of the TSF. The towers, with heavy-duty hoisting equipment attached at their tops, are 39 m apart and are capable of lifting and dropping casks from heights of 80 m. Casks weighing 160 metric tons can be tested at 9 m, whereas lesser weight casks can be handled at greater heights. This facility is unique in the free world.	Acceleration and Strain data Photometric Coverage	$10,000 - 100,000	Larry B. Shappert Oak Ridge National Laboratory P. O. Box X Oak Ridge, TN 37830 (615-576-2066)

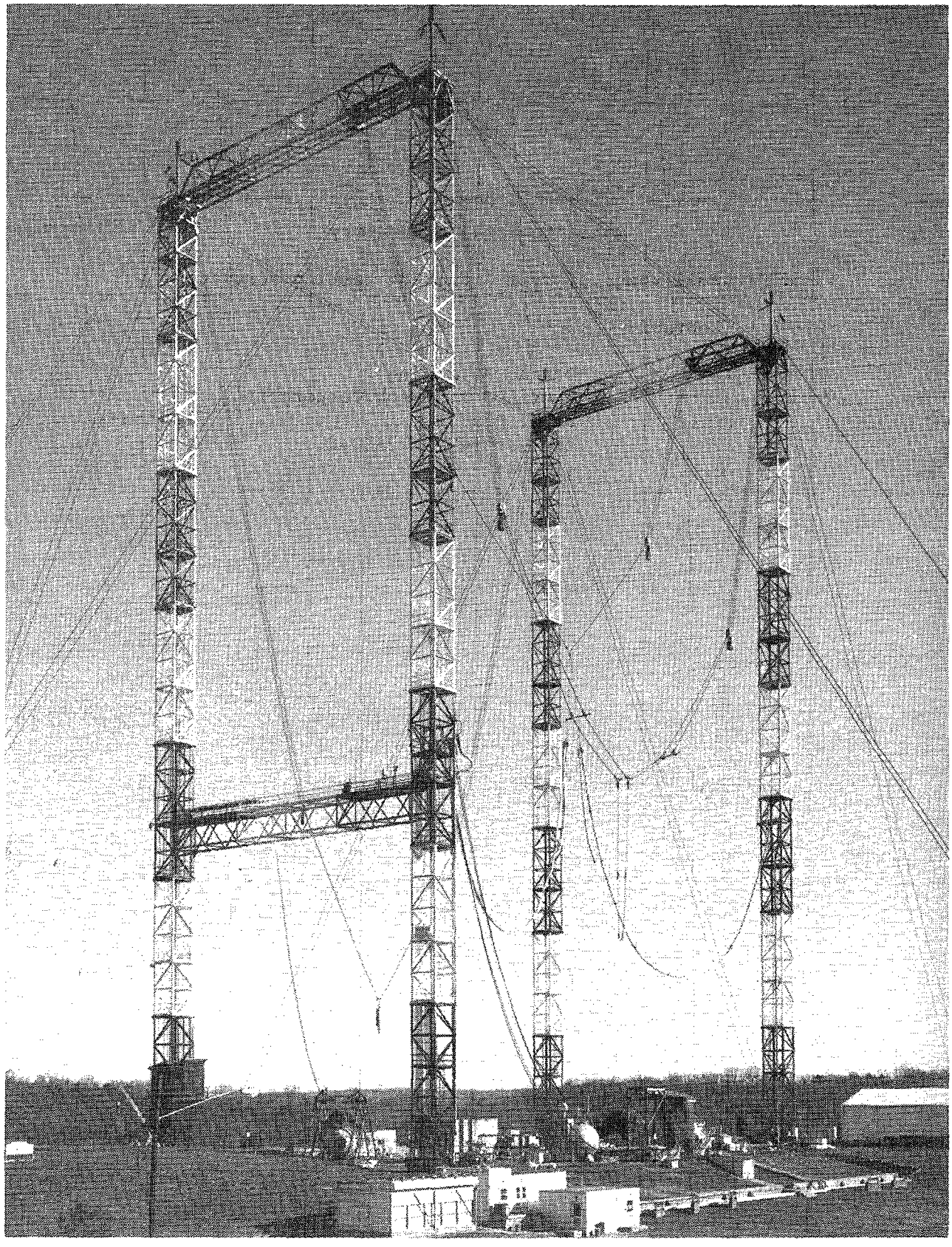


Fig. 1. Tower Shielding Facility.

Monsanto Mound Laboratory

- Full range of Type A package testing services
- Contact:

Donald A. Edling
Monsanto Research Corporation
P. O. Box 32
Miamisburg, OH 45342
(513-865-3919)

Attachment B: Commercial Facilities

Commercial Packaging Certification

Test Capability in the U. S.*

*Based upon results from Industry Survey conducted by Teledyne Energy Systems.

Commercial U. S. Organizations with Packaging Test Capabilities

Organizations that Responded to Survey and Supplied Details on Testing Capability

(1) Nuclear Packaging Inc.
815 South 28th St.
Tacoma, WA 98409

Testing Services:
Impact, Puncture
Crush & Water Immersion

Contact: Larry J. Hansen
(206-572-7775)

(2) Southwest Research Institute
620 Culebra Rd.
San Antonio, TX 78384

Testing Services:
Impact, Puncture
Crush, Thermal
Water Immersion

Contact: William Baker
(512-684-5111)

(3) Stearns-Roger Manufacturers Inc.
4500 Cherry Creek Dr.
P. O. Box 5888
Denver, CO 80217

Testing Services:
Thermal Water Immersion

Contact: W. H. Brinkman
(303-758-1122)

(4) Factory Mutual Research Center
1151 Providence Highway
Norwood, Mass. 02062

Testing Services:
Fire Tests

Contact: Jeff Newman
(617-762-4300)

Nuclear Packaging, Inc.
Packaging Certification Test Capability

Impact, Puncture and Immersion Testing

- Weight Limit: 20 tonne
- Maximum Package Dimensions:

  2.5 m x 2.5 m x 6 m

Thermal Testing: Not available

Stearns-Roger Manufacturers Inc.

Immersion Testing

Maximum Package Dimension:

1.5 m diameter x 3 m length

Thermal Testing

Maximum Test Temperature: 450°C

Maximum Package Dimension: 6 m

Maximum Package Weight: 9 tonnes

Maximum Test Duration: Open

Southwest Research Institute
Packaging Certification Test Capabilty

Impact and Puncture Testing

- Weight Limit: 28 tonne
- Maximum Package Dimensions
  9 m x 9 m x 9 m

Thermal Testing

- Maximum Test Temperature: 1100°C
- Maximum Package Dimensions:
  3 m x 2 m x 3 m
- Maximum Weight: Open
- Maximum Test Duration: Open

Immersion Testing

- Maximum Package Dimensions:
  6 m x 6 m x 18 m
- Weight Limit: Open

Attachment C: Other Facilities

Department of Transportation and Other U. S. Government Supported Testing Facilities

Additional Transportation System Test Facilities in the U. S. without Current Radioactive Material Packaging Certification Testing Experience

Facility	Contact	Type of Testing
Transportation Research Center of Ohio	Larry A. Slotten Transportation Research Center East Liberty, Ohio 43319 (513-666-2011)	Highway Vehicle Testing
Federal Aviation Administration Technical Center	Michael Benson Dept. of Transportation Federal Aviation Administration Technical Center Atlantic City Airport, NY 08405	Air Transport System Testing
FRA Transportation Test Center	Trevor Chapman FRA Transportation Test Center Pueblo, CO 81000 (303-326-9508)	Rail Transport System Testing
China Lake Naval Weapons Center	Ben Tozer China Lake Naval Weapons Center Code 6212 China Lake, CA 93555 (714-939-7357)	Open Pool Fire Testing
NASA White Sands	Larry Linley NASA White Sands Test Facility P. O. Drawer MM Las Cruces, NM 88004 (505-524-5722)	Open Pool Fire Testing