NRC FORM 658
(9-1999)

U.S. NUCLEAR REGULATORY COMMISSION

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DATE OF MEETING
06/05/2003

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Docket Number(s)	**PROJ0722**
Plant/Facility Name	**Advanced CANDU Reactor (ACR-700)**
TAC Number(s) (if available)	**MB5765**
Reference Meeting Notice	
Purpose of Meeting (copy from meeting notice)	**AECL technical presentation during the visit to the RD-14M Facility**

NAME OF PERSON WHO ISSUED MEETING NOTICE	TITLE
Belkys Sosa	**Project Manager**

OFFICE
NRR

DIVISION
NRLPO

BRANCH

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Large-Scale Vented Combustion Test Facility

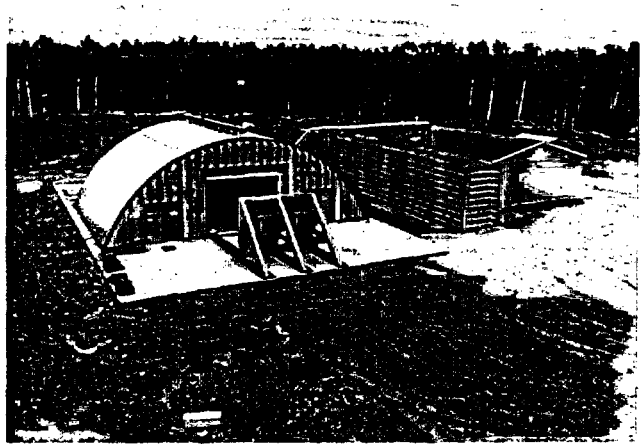
AECL's Large-Scale Vented Combustion Test Facility (LSVCTF) is a 10-m long, 4-m wide, 3-m high rectangular enclosure with an internal volume of 120 m^3. It is constructed of 1.25 cm thick steel plates welded to a rigid framework of steel I-beams. Two roller-mounted movable end walls are provided to open up the vessel for internal modifications or to move in bulky experimental equipment when needed. The combustion chamber and associated equipment is enclosed in an insulated metal Quonset. The test chamber, including the end walls, is electrically trace-heated and heavily insulated to maintain temperatures in excess of 100°C for extended periods of time. This is the only large-scale facility in North America that can be used to perform combustion tests with hydrogen-air-steam mixtures. This combination of large scale, geometry versatility and control of initial conditions is unique in the world.

The combustion chamber can be subdivided into 2 or 3 compartments using structural steel partitions. Variable sizes of vent openings are available between compartments and to the outside. The facility has three separate gas addition systems for steam, hydrogen, and inert gases. Hydraulic fans inside the test chamber are used to mix the gases and to provide turbulent conditions during combustion. Instrumentation includes pressure transducers, thermocouples, and gas sampling by mass spectrometer, at several locations inside the test chamber. The facility uses a customized Labview® program for data acquisition and data management.

The facility is located in a fenced area and is remotely operated to ensure operator safety.

Key Features of LSVCTF

- variable vent opening
- rectangular interconnected chambers
- removable end walls for easy access
- 200 kPa design pressure
- state-of-the-art data management system
- chambers can be trace heated to 100°C
- mass spectrometer for gas concentration measurements
- remote operation for operator safety



AECL's Large-Scale Vented Combustion Test Facility is well suited for tests involved interconnected chambers

Combustion Program at AECL

Hydrogen is a flammable gas produced during some types of accidents in nuclear reactors. The gas is released when overheated metals are exposed to steam in the reactor core. When mixed with containment air, hydrogen can burn and produce unacceptable pressures and damage equipment within the containment building. A Canadian research program on hydrogen combustion and containment behavior was initiated at Whiteshell Laboratories in the late 1970's. The objectives of the research

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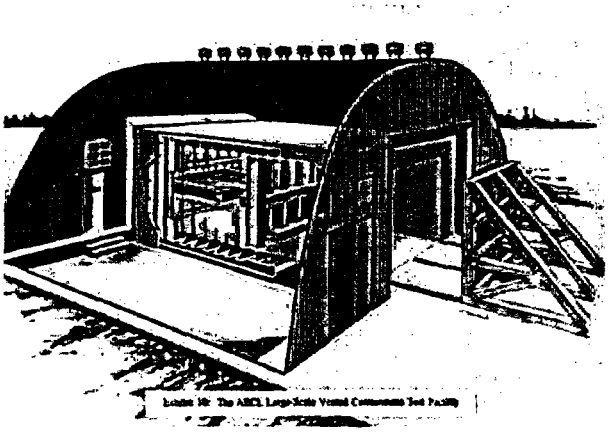
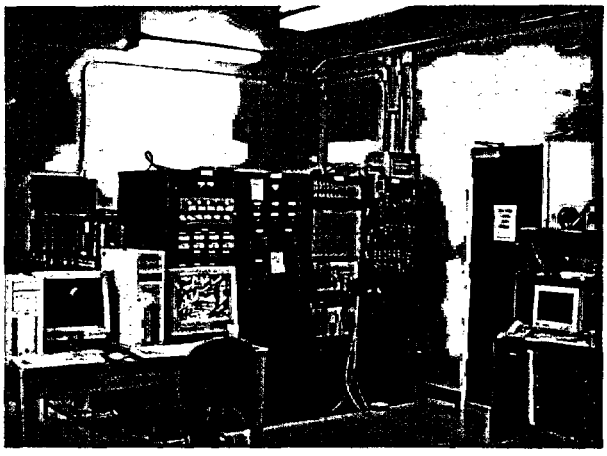
program were to reliably predict and design means to mitigate hydrogen combustion in reactor-containment structures.

Environmental Qualification Assessment and Testing

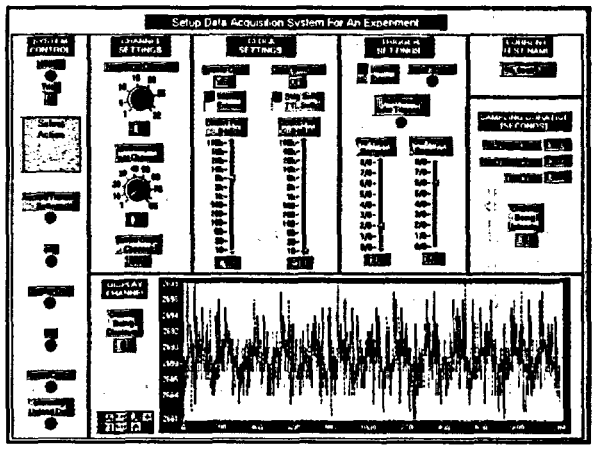
The LSVCTF is a fully serviced and instrumented test vessel that lends itself well to environmental qualification assessment and testing under severe conditions.



LSVCTF can be subdivided into 2 or 3 compartments using structural steel partitions.



LSVCTF control room and its data acquisition system



The facility uses "Labview", a state-of-the-art data acquisition system, for data management.

For more information, please contact
Reactor Safety Division
Containment Analysis Branch
Whiteshell Laboratories
Pinawa Manitoba, R0E 1L0
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Diffusion Flame Facility

AECL's Diffusion Flame Facility (DFF) at Whiteshell Laboratories consists of a burner with associated gas supply lines and instrumentation housed within a modified grain silo (5 m diameter and 8 m height), which was elevated 1m off the ground for ventilation purposes and insulated to retain heat for experiments that invole an air / stream environment. Tests with H_2 / stream jet flames (up to 15 cm in diameter) in air / stream atmosphere (up to 30% steam by volume) can be performed in this facility.

AECL's Diffusion Flame Facility is a 5-m-diameter, 8-m-height insulated enclosure. Hydrogen-steam diffusion flame tests up to 15 cm diameter can be performed in this facility.

Key Features of DFF

- 20 m^3 cylindrical enclosure
- insulated wall
- real-time multi-point temperature measurements
- air-steam atmosphere up to 60°C
- hydrogen jet preheated to 600°C
- hydrogen jet velocity up to 500 m/s

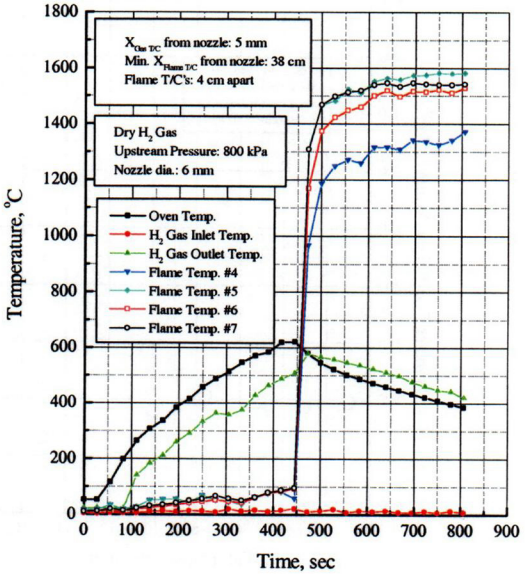
Diffusion Flame Experiments

The Objectives

- to provide information and tools to support the demonstration that the containment system design is adequate to limit the consequences of a postulated LOCA
- to determine the stability regime, time-average flame temperature and heat load to nearby objects for various hydrogen diffusion flames

Flame Temperature Measurement

Time-averaged flame temperature can be measured for a hydrogen jet up to a velocity of 500 m/s and initial temperature of 600°C.



Flame Temperatures of a dry hydrogen jet preheated to 500°C

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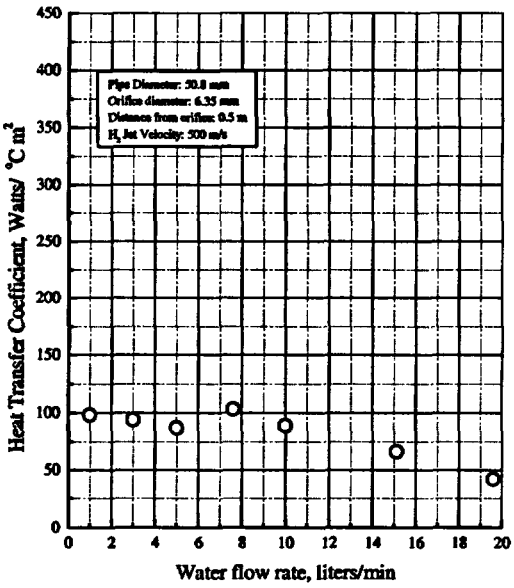
Heat Load to Flame-Impinged Objects

Engineering correlations have been determine for determining the heat load on protected and non-protected flame-impinged flat plates and cylinders.

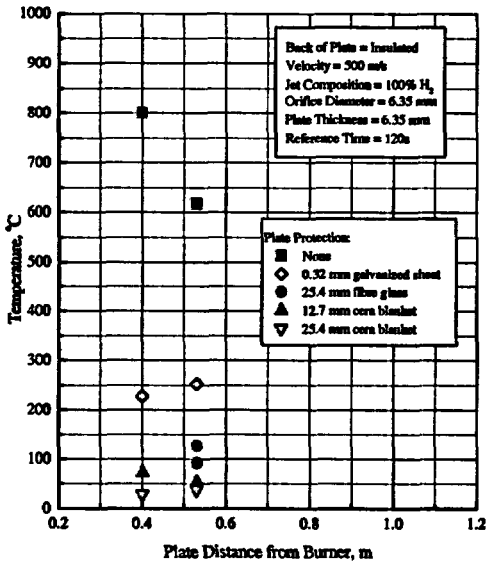
Heat flux on protected and non-protected objects has been determined.



Flame Impinged Heat-Transfer Coefficient of a 50.8-cm-diameter, 12.7-mm-thick Pipe with Circulating Water Flow

Thermal Protection

Various types of insulation material have been tested. It was found that heat load to a flame impinged object can be significantly reduced (>95%) by protecting the surface with a layer of thermal insulation such as a cera blanket.



Temperature on a 6.35-mm-thick Unprotected and Protected Steel Plates with Various Types of Insulation

For more information, please contact
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Containment Test Facility

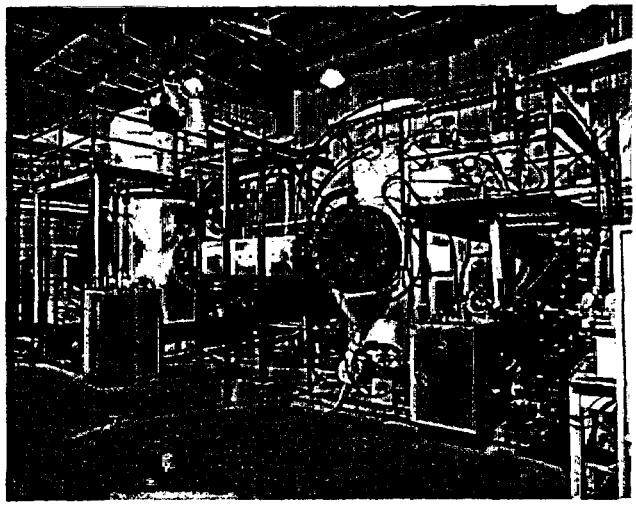
The Containment Test Facility (CTF) at Whiteshell Laboratories consists of a 6-m^3 sphere and a 10 m^3 cylinder, both rated for pressures up to 10 MPa and trace-heated for operation at temperatures up to 150°C. The large vessels may be interconnected by 30 cm and 50 cm diameter ducts. The CTF is designed to investigate the fundamentals of combustion phenomena. These include flammability limits, ignition, turbulent combustion, flame acceleration, detonation, detonation transition, and dust explosions.

Objectives of the Combustion Program at AECL

Hydrogen is a flammable gas produced during some accidents by a reaction between steam and overheated metals in the reactor core. When mixed with containment air, hydrogen can burn and produce unacceptable pressures within the containment building. A Canadian research program on hydrogen combustion and containment behavior was initiated at Whiteshell Laboratories in the late 1970's. The objectives of the research program were to reliably predict and design mans to mitigate hydrogen combustion in reactor-containment structures.

Key Features of CTF

- Vented and unvented tests
- Interconnected pipes of different lengths (up to 6 m) and diameters (up to 0.45 m i.d.)
- Large man-holes for easy access
- 10 MPa design pressure
- State-of-the-art data management system



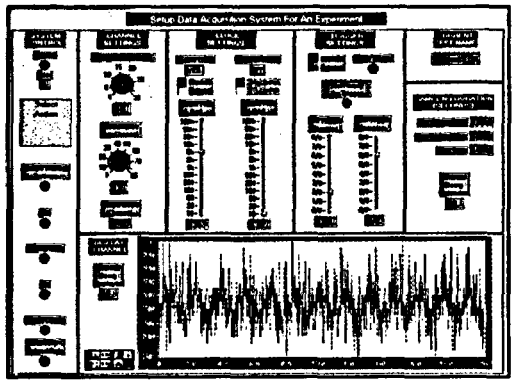
The Containment Test Facility at Whiteshell Laboratories consists of a 6-m^3 sphere and a 10-m^3 cylinder, both rated for pressures up to 10 MPa

Types of Combustion Studies

- Ignition by hot surfaces
- Flame jet ignition
- Vented combustion
- Burns in interconnected vessels
- Obstacle induced flame acceleration
- Burns in non-uniform mixtures

Data Acquisition System

CTF tests are performed remotely. The facility uses "Labview", a state-of-the-art data acquisition system, for data management.



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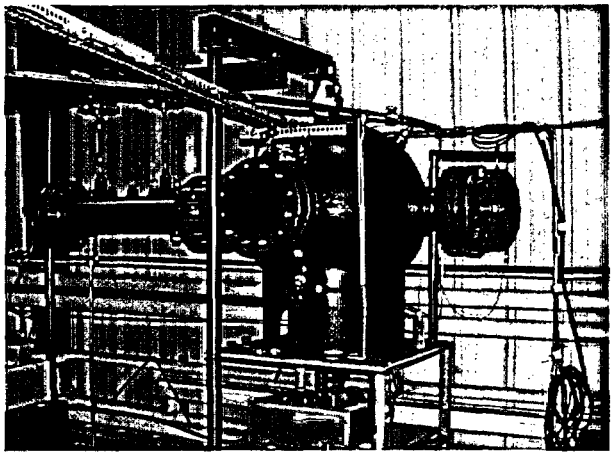
Others Combustion Vessels

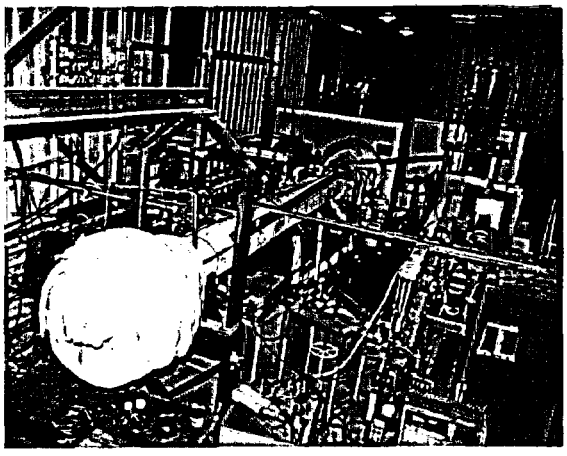
The Medium-scale Combustion Sphere

This test vessel consists of a 0.76-m-I.D. sphere attached to a 1.12-m-long and 0.145-m-diameter pipe, with a total volume of approximately 0.252 m^3. The vessel is rated for an overpressure of 5.0 MPa at 100° C. This vessel was designed to study flame jet ignition and Deflagration to Detonation Transition (DDT) phenomena.



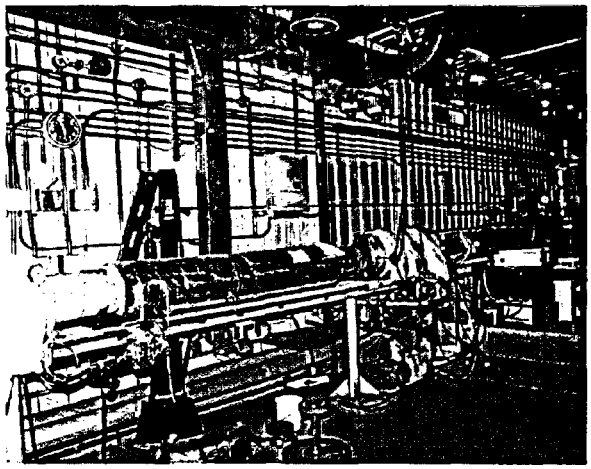
0.28-cm-diameter Combustion Duct

This is a 6-m-long steel vessel, rated for an overpressure of 10 MPa, was designed for studying flame acceleration and DDT phenomena. This apparatus has been used for determining the DDT limits and transition run-up distances.



15-cm-diameter Detonation Tube

This 15-cm-diameter, 6-m-long detonation tube can be trace heated to 200°C. It was designed for detonation studies. This apparatus when divided into two sections can be used as a shock tube. It has been used for determining the ignition limit resulting from shock focusing.



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