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Memorandum

Date	: 21 June 2006	**Project**	: Project Specification Claus C Power Plant
To	: Edwin Plug	**Project No.**	: 64601-00
From	: Grace Abutan	**Our reference**	: 64601-00-M-ABG-0001
Subject	: MCA of gas receiving station	**File**	:
Copies to	:		

Introduction

As part of the Project Specification Claus C Power Plant, Essent Energy in Geertruidenberg, has asked Jacobs Consultancy to perform a Maximum Credible Accident (MCA) assessment on a gas receiving station at the Geertruidenberg site.
The hazardous effect contours Essent asked to determine for the MCA are:

Explosion:	0.3 and 0.03 bar overpressure contours
Toxic or suffocation:	5% and 1% lethality contour
Fire:	15 kW/m^2 heat radiation contour

The effect calculations are executed with the Phast program issue 6.42.

Situation

Two gas receiving stations (owned by the Gasunie) are located on the Essent Energy site, south west of the cooling tower unit A. The underground 12” gas pipeline comes above ground in the gas receiving station were the gas is reduced from 55-60 barg to approximately 11 barg.

The main equipment inside the building are pipelines, (control)valves, filters, flow meters, instruments and heat exchangers.

MCA scenario

According to the PGS 3 [ref.1] possible accident scenario's with pipelines to be considered are full bore pipe rupture and pipe leakage (leakage hole size of 10% of the nominal diameter, with a maximum of 50 mm).
A full bore 12" pipeline rupture inside the gas receiving station is not credible, as the surrounding building will protect the pipe from most outside impacts and decreases the

corrosion potential. However, pipe leakage (e.g. a flange) or a leakage or rupture of an instrument connection is seen as a feasible scenario. The assumed hole size for this scenario is therefore taken as 50 mm with the release in the horizontal direction (worst case direction) within a building.
Further it is assumed that the gas receiving station has only natural ventilation (3 air changes per hour).

Hazardous effect contours

A release of natural gas may result in a fire or an explosion. The PGS 3 [ref.1] and PGS 1 [ref.2] gives a hazardous effect overview on people and property resulting from pressure waves and heat radiation.

Hazard	Damage/injury
0.03 bar overpressure	Breakage of glass windows
0.1 bar overpressure	10% of building severely damaged
0.3 bar overpressure	Severe damage to buildings
3 kW/m^2 heat radiation	Pain threshold after 30s exposure
10 kW/m^2 heat radiation	Lethal injury within several minutes
15 kW/m^2 heat radiation	Ignition of wood/ damage of plastic.

All these hazardous effect contours are calculated and the maximum effect distance is determined.

Two types of explosions are distinguished: early and late. Early explosion is the immediate ignition of the cloud and late explosion is the ignition of the vapor cloud drifting away. The ignition point that has been considered for late explosion, is the location as far away as possible (where ignition of the cloud is still possible).
Both the hazardous effect contours of a late and early explosion have been determined.

All scenario's are calculated with several weather types and wind speeds, to determine the worst case.

Results

For every hazardous effect the worst case contour and distance has been determined.

Early explosion (see attachment 1):

Overpressure	Maximum hazardous effect distance
0.03 bar	45 meters
0.1 bar	19 meters
0.3 bar	10 meters

Late explosion (see attachment 2):

Because for late explosion the hazardous effect depends on the location of the ignition, the worst case has been taken. The largest distance to which the vapor cloud still can be ignited is 84 meters.

Overpressure	Maximum hazardous effect distance
0.03 bar	125 meters
0.1 bar	102 meters
0.3 bar	93 meters

Heat radiation (see attachment 3):
In case the natural gas leak will result in a jet fire, the following heat radiation effect distances will apply.

Heat radiation	Maximum hazardous effect distance
3 kW/m^2	68.5 meters
10 kW/m^2	61.5 meters
15 kW/m^2	61 meters

In the attachments the effect contours are given.

Conclusion

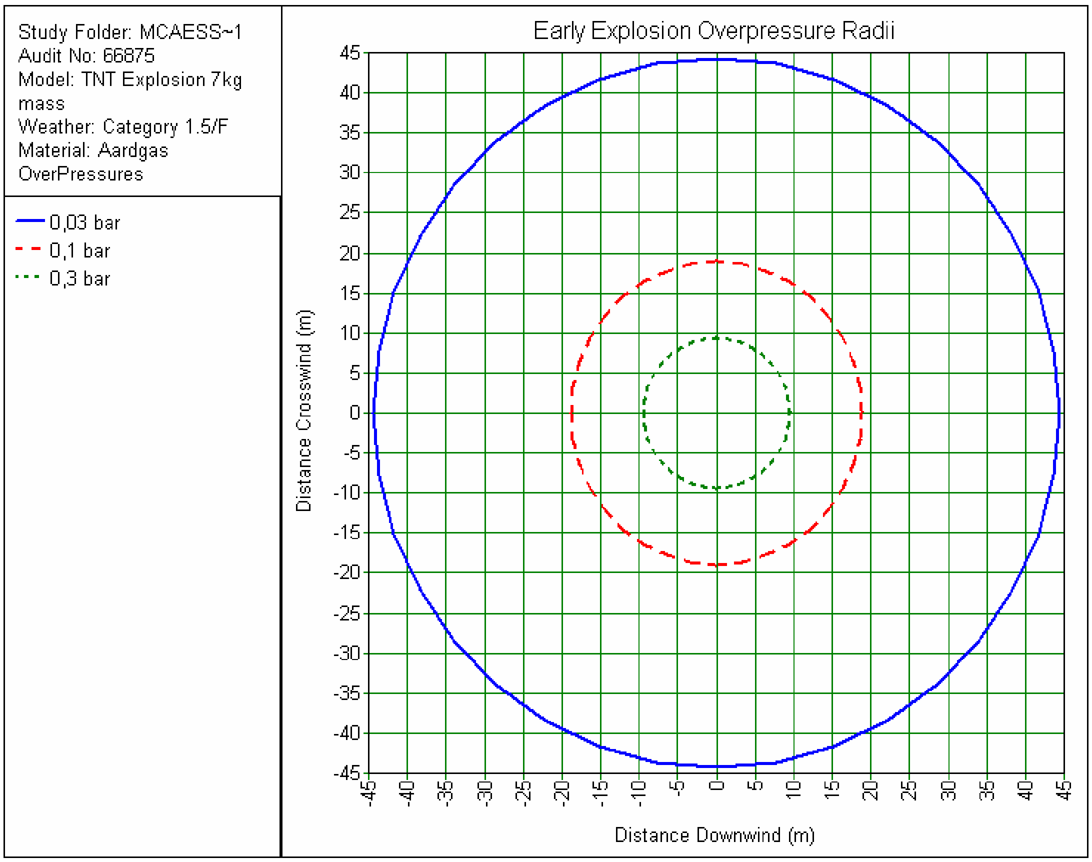
Buildings with an office function or critical safety control function shall be outside the 0.3 bar effect distance, hence at a minimum distance of 93 m. Furthermore, it is preferred that they are outside the 0.03 bar effect distance, hence 125 meters. If these buildings are within the minimum distance they should be blast proof against 0.3 bar.
Wooden buildings or critical plastic parts (e.g. electrical cables) should be outside the 15 kW/m^2 effect distance, hence at minimum distance of 61 meters. If this is not the case, fire proofing has to be considered.

Reference:

1. Publicatiereeks Gevaarlijke Stoffen 3 (PGS 3). Guidelines for quantitative risk assessment.
2. Publicatiereeks Gevaarlijke Stoffen 1 (PGS 1). Methoden voor het bepalen van mogelijke schade.

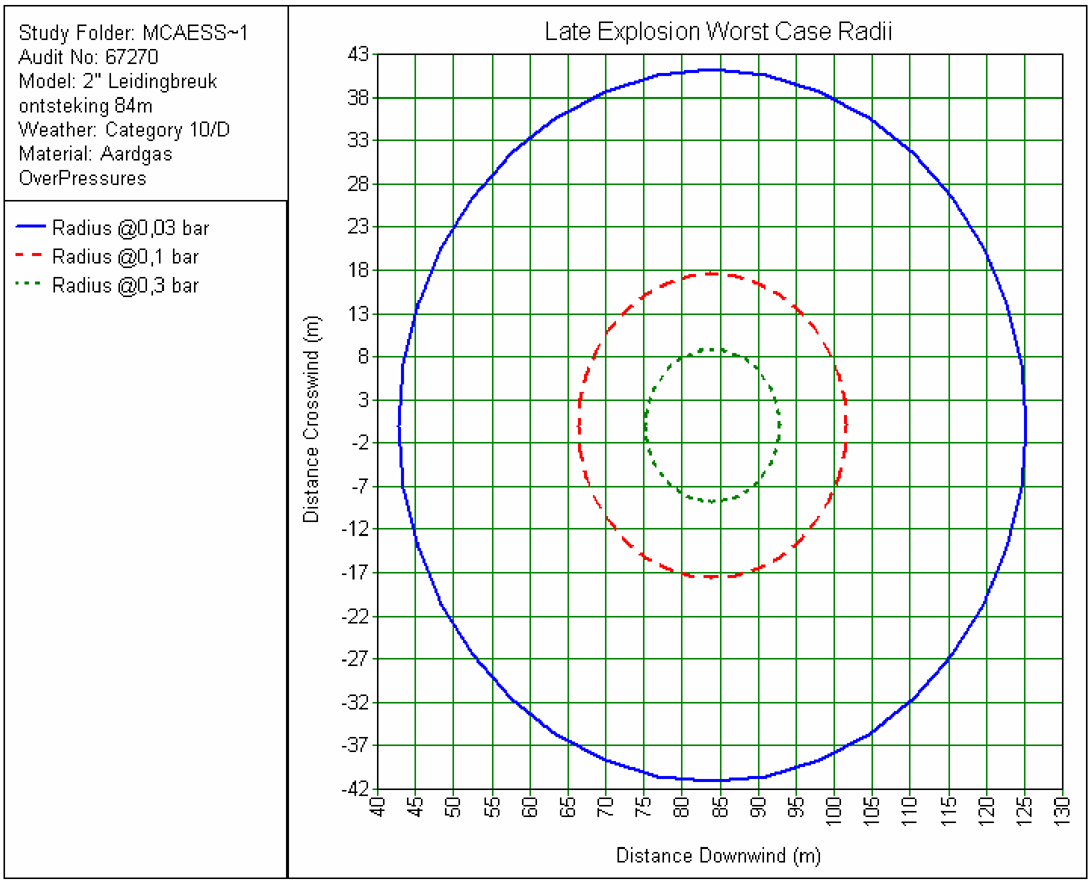
<u>Attachment 1:</u>

0.03, 0.1 and 0.3 bar overpressure contour for early explosion



Attachment 2:

0.03, 0.1 and 0.3 bar overpressure contour for late explosion



Attachment 3:

3, 10 and 15 kW/m^2 heat radiation contour