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		Rev: 01
		Aug 2013
KLM Technology Group #03-12 Block Aronia, Jalan Sri Perkasa 2 Taman Tampoi Utama 81200 Johor Bahru Malaysia	INSPECTION, MAINTENANCE, REPAIRS AND REHABILITATION OF FOUNDATIONS AND STRUCTURES (PROJECT STANDARDS AND SPECIFICATIONS)	

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SCOPE

This Project Standards and Specification covers the inspection, maintenance, repairs and rehabilitation of foundation and structures.

CHAPTER I

INTRODUCTION

INTRODUCTION

The civil foundations and structures are vital components in an oil industry installation. It is the general experience that these components do not get the deserved attention. Since the consequences of even a partial failure of these components could be catastrophic, these need related maintenance and inspection practices.

SCOPE

This Standard intends to provide guidelines to the Oil Industry personnel with regard to the maintenance, inspection, repairs and rehabilitation of various civil structures and foundations.

For the purpose of this Standard, the civil structures involved in oil industry installations have been grouped into the following sections:

- a) Tank pad foundations and dike walls
- b) Equipment foundations
- c) Buildings and structures
- d) Pipe racks and tracks
- e) Marine structures
- f) Concrete - general inspection and repairs

It is assumed that the users of this Standard are conversant with the terminology used and will have basic knowledge about of causes of deterioration of various types of foundations and structures.

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All records, basic design parameters, "as built" drawings and history of construction of various components of foundations and structures should be kept at one place and under a controlling authority for ease of reference during subsequent inspections/maintenance.

All the subsequent modifications to the structure and foundations shall be duly marked on the original drawing itself. The record of details of the job carried out shall also be maintained for future reference

CHAPTER II

TANK FOUNDATIONS & DIKE WALLS

INTRODUCTION

This chapter deals with the recommendations for inspection, maintenance, repairs and rehabilitation of tank foundations and dike walls. The rehabilitation of the tank foundation may become necessary in case of excessive settlements, erosion etc. which will lead to shell distortion, excessive tension in bottom plates and piping causing to their failures.

TANK FOUNDATIONS

1. INSPECTION

A successful inspection / maintenance program for tank foundations depends upon the factors which include (but are not limited to) the following:

- a) Checking of tank settlements. - Normally equidistant angle cleats are welded to the tank periphery at the time of construction at a fixed height from tank bottoms. Levels are to be taken with respect to a fixed datum, which is not affected by tank settlement.
- b) Adequacy of drainage system.
- c) Checking of grass growth/shrubs etc on tank pad/apron.
- d) Erosion of tank pad/apron.
- e) Checking of chemical analysis of concrete for ruling out alkali-aggregate reaction induced cracks.

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- f) Condition of joint between tank bottom & foundation.
- g) Maintenance and upkeep of Tank farm area including pathways
- h) Spillage of any tank contents on tank foundation from joints on suction/discharge lines of tank which may damage/ erode tank foundation.

2. FREQUENCY OF INSPECTION

- a) Routine visual inspection should be carried out at least twice a year or after any major accidents / natural calamity.
- b) The detailed inspection should be carried out every 5 years or during the M&I shutdown whichever is earlier. This shall also include the settlement readings along the periphery of tank at already established points.
- c) During internal inspection of storage tanks, undulation/ cracks in the bottom plates should be examined specifically, from the viewpoint of localized subsoil settlements.

3. MAINTENANCE

Minor rectification work such as filling of thin cracks, replacement of eroded material in the slope, patch work, and storm oily water drainage system shall be immediately attended to.

A checklist must be followed for each tank as detailed below:

- a) Health of tank Pad : Horizontal portion and slope of the tank pad should be checked against undulation/erosion of bituminous layer and for exposure of sand/rubble core etc.
- b) Slope of tank farm area for easy flow of rainwater towards the sum to avoid water logging.
- c) Grass/bushes/vegetation on the tank pad and tank farm area to be removed.
- d) No unlined pits are to be allowed near tank periphery (lining to be done by concrete).
- e) Any deterioration / cracks in concrete (if the tank rests on ring wall type foundation).

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4. REHABILITATION

- a) Rehabilitation of the tank pad foundation may be necessitated due to excessive settlement.
- b) Uniform settlements to the extent that they do not affect tank piping connections are not harmful for tank performances. Differential settlements may lead to shell distortion, excessive tension of bottom plate, and additional stresses on connected pipe nozzles and pipeline resulting in failure. Such failures may also cause additional hoop stresses in the Ring Beam causing failure of hoop reinforcement.
- c) The tank foundation rehabilitation may involve major repair such as jacking and leveling of the tank, replacement of annular bottom plate, construction of new foundation, strengthening and re-grading of the tank pad wherever necessary.
- d) In situation where entire raising of tank for rehabilitation of tank foundation is impracticable, construction of ring wall by removing the sketch plate is suggested.
- e) The foundation settlement as apparent from the local distortion/undulation in the bottom plates may be rectified by cutting small openings of say 150 x 150 mm in the bottom plate and filling sand with compressed air. Molten bitumen is then poured in order to make the layer anticorrosive and an integral part of the existing foundation.
- f) To avoid/prevent soil erosion a suitable toe wall with proper drainage system along the periphery of tank pad may be considered.

DIKE WALLS

The reconstruction/repairs of dike walls shall be carried out using suitable materials as per standard practices. Periodic inspection of dike wall shall include:

- a) Checking of grass/shrubs on the dike wall
- b) Erosion and loss of height
- c) The methods and materials of construction and repair adopted earlier
- d) Condition of joints in case of masonry/concrete dike wall
- e) Condition of drainage system around and within the dike wall.
- f) Development of cracks on masonry walls