

香港中華煤氣有限公司 立管檢查機械人

二零一一年七月十二日

第九屆香港職業安全健康大獎 安全改善項目大獎 - 金獎



公司背景

煤氣公司的使命

為客戶供應安全可靠的燃氣，並提供親切、專業和高效率的服務，同時致力保護及改善環境。



煤氣的輸送

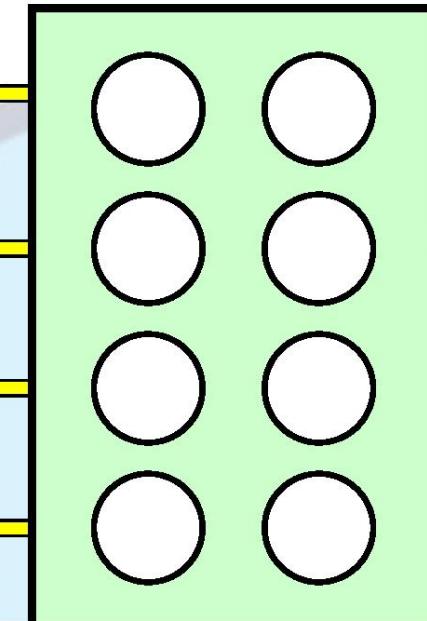


生產廠房



地下煤氣輸送喉管

立管
用戶所居住大廈



立管 (Riser)

- 安裝於大廈外牆
- 供應煤氣到每個用戶的家中
- 長期曝露於室外環境
- 大廈管理保養計劃會影響其壽命



立管銹蝕之級別



1級 - 良好立管



2級 - 輕微 蝕



3級 - 中度 蝕



4級 - 嚴重 蝏



5級 - 極嚴重 蝏



6級 - 喉管漏氣

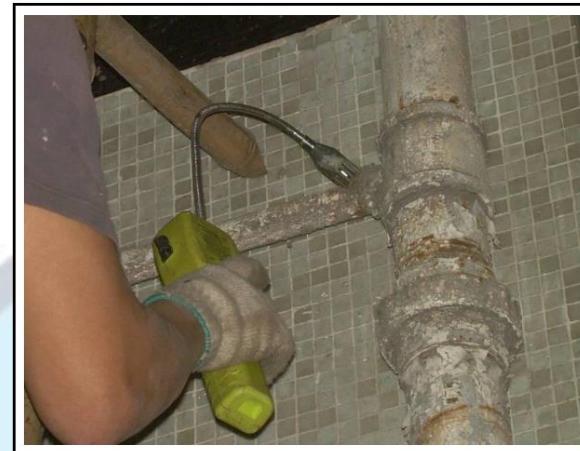
立管檢查 (1)

- 透過每十八個月煤氣定期安全檢查時
檢查立管
 - 從窗戶探頭作檢查
 - 確保立管沒有嚴重锈蝕
或氣體洩漏情況
- 定期安全檢查進戶率只有50%
- 整體立管檢查率僅達 40%
- 無法全面了解到立管锈蝕狀況
- 最終引致氣體洩漏事故

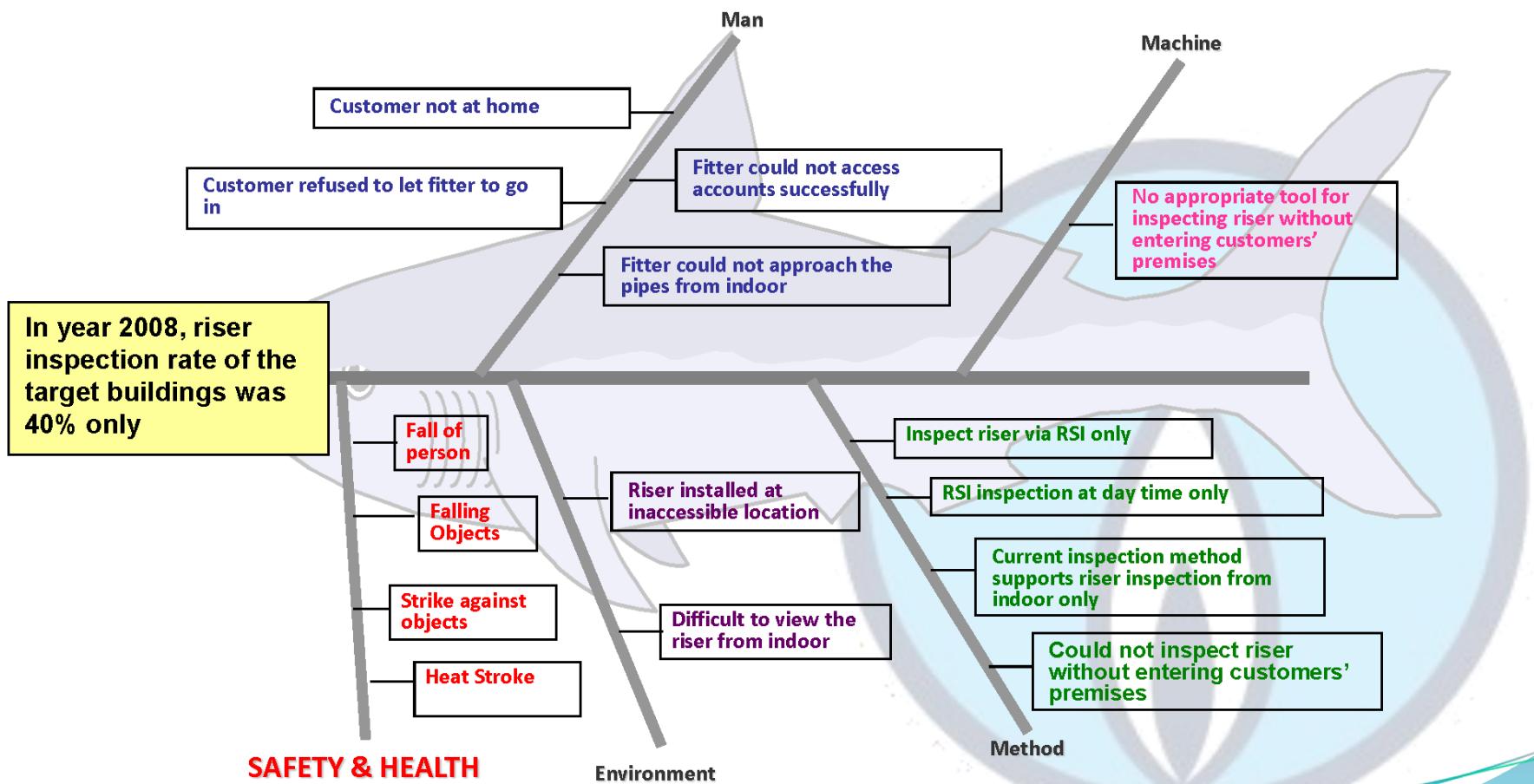


立管檢查 (2)

- 大廈進行樓宇維修時，在大廈外牆搭建棚架
 - 煤氣公司安排前線人員上棚檢查立管
 - 全面檢查立管狀況
- 高空工作乃屬高風險作業
- 上棚檢查立管相對被動
- 沒有棚架就無法檢查



魚骨圖



風險評估

- **高風險項目**
 - 高空工作
 - 人體下墮
 - 高空墮物
 - 氣體安全
 - 其他
 - 於狹窄環境下工作
 - 撞向固定物件
 - 立管檢察比率…等

根據勞工處報告,於2009年建造業共發生19宗死亡事故,當中15宗是關於高空工作。
可見高空工作的危險性!

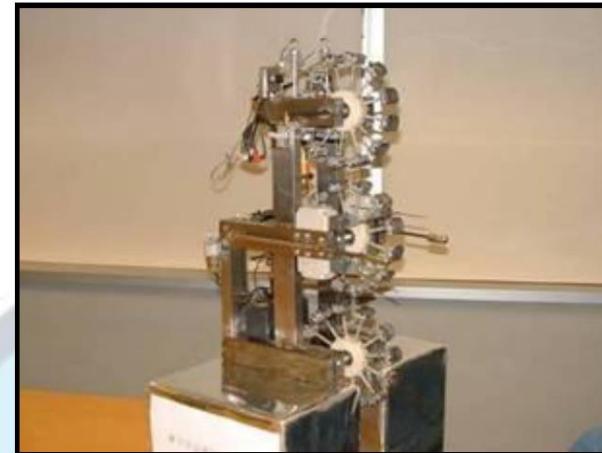


根據風險評估結果
消除方法
降低風險

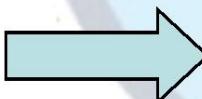
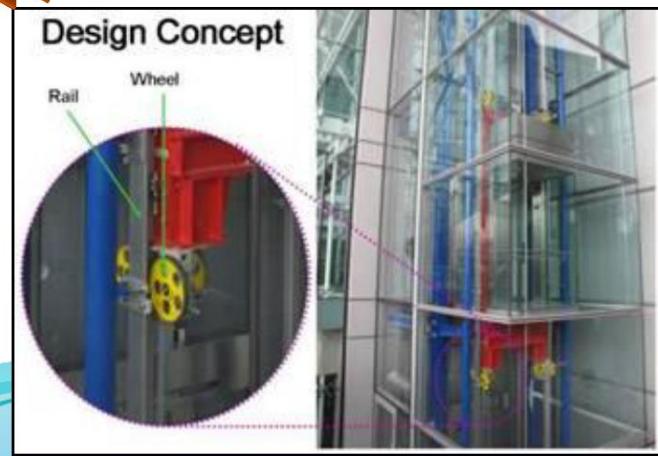
立管檢查機械人

設計概念

- 機械人的要求
 - 安全地架設在大廈外牆
 - 能穩定地升降進行檢查
 - 能記錄鎽蝕狀況
 - 能探測氣體洩漏



升降機的運作原理



機械人的結構(1)

- 使用絞盤及索纜進行升降
- 利用兩條索纜及負重物形成路軌
- 機械人可在路軌行走，對立管作出測漏檢查



機械人的結構(2)

- 架設於天台的穩固裝置
 - 利用水桶作機組固定及平衡
 - 分裝組件，方便搬運
 - 備有車輪，方便移動



機械人的結構(3)

- 機械人的核心部份
- 安裝氣體探測器及數碼鏡頭，
收錄立管狀況
- 透過無線網絡系統，即時將
影像及聲音傳送到手提電腦



氣體探測器

數碼鏡頭

吊索工具檢測証書

根據<工廠及工業經營(起重機械及起重裝置)規例>對所使用的吊索等工具作出檢測

Certificate No.: LACG-100118-TG01-WN

Name of owner 擁有人姓名

HK & China Gas Co. Ltd.

Address of installation 安裝地址

Block 3, Fulview Garden, Siu Si Wan, Hong Kong
(From GP to Roof above Plat J of 26/F)

FORM 3
表格二
Factories and Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulations
CERTIFICATE OF TEST AND THOROUGH EXAMINATION OF
ANCHORING OR BALLASTING OF CRANES

Form approved by the Commission for Lifting for the purposes of regulation TGD 8 (3) of the
Factories and Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulations

工廠及工業經營(起重機械及起重裝置)規例第TGD 8(3)條的需要而認可

本表格乃由工務處長或工廠及工業經營(起重機械及起重裝置)規例TGD 8(3)條的需要而認可

Description of crane and means
of identification
起吊機的類別及識別方法

(1)

Winch System of Gas Pipe Inspector

Two electric winches severely damaged on a
steel car. An anchor box suspended onto the
arm of steel car with 2 fall 3 mm dia. wire
rope. An inspector box run along the 2 falls
wire rope as guide and suspended by another
3 mm dia. 1 fall wire rope.

Maker : HK Polytechnic University

Year : 2009

Winch SN: 000920381 (Inspector Box)

012862066531 (Anchor Box)

Test applied:
測試方法:

(2)

Load imposed (tonnes)
荷重(以公噸為單位)

Radius of jib crane
吊臂半徑
(以公呎為單位)

Anchorage tested
驗證地點

Load (tonnes)
荷重(以公噸為單位)

Result of test
測試結果

Every details of repairs required or defects.
If none enter "In safe working order".
每項修理
如無不足，則註明“處於安全操作狀態”

註明不足，則註明“處於安全操作狀態”

(3)

38 kg

1.8 M

1.8 M

30 kg
(Inspector Box)

"None" of defect and
in safe working order

註明不足，則註明“處於安全操作狀態”

(4)

50 kg

1.8 M

1.8 M

40 kg
(Anchor Box)

"None" of defect and
in safe working order

註明不足，則註明“處於安全操作狀態”

(5)

I hereby certify that the anchoring and ballasting of the crane described in this certificate was tested and thoroughly examined by me on 18 Jun, 2010, and that the above particulars are correct.

我謹此保證，本證書所列的起吊機已於2010年6月18日經過仔細檢查，並上列各項均屬正確。

Signature of Registered Professional Engineer

註冊專業工程師簽名

Date of certificate

2010年6月18日

Qualification
資格資歷

Diploma
文憑

Mechanical, Building Services (RPO25950)

Any competent engineer or competent person who delivers to an owner a certificate or makes a report which is in his knowledge false or in a material particular shall be guilty of an offence and shall be liable on conviction to a fine of \$200,000 and to imprisonment for 12 months.

任何合格工程師或合資格的人，如向擁有者交付一個在知識上虛偽或在重要事實上與事實不符的報告，則會犯上一項罪行，可罰款二十萬元及監禁十二個月。

LALG-02

新嘉坡銀行有限公司 Sun Professional Engineers Services Ltd. Phone: 2775-6268 Fax: 2775-6298 Notice: 630-066

Certificate No.: LACG-100118-TG01-WN

Form 3/1

CERTIFICATE OF TEST AND THOROUGH EXAMINATION OF CRANE
CRANE AND GEAR

Form approved by the Commission for Lifting for the purposes of regulation TGD 8 (3) of the Factories and Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulations

工廠及工業經營(起重機械及起重裝置)規例第TGD 8(3)條的需要而認可

本表格乃由工務處長或工廠及工業經營(起重機械及起重裝置)規例TGD 8(3)條的需要而認可

(1)

Load tested (tonnes)

Radius of jib crane

Anchorage tested

Load (tonnes)

Result of test

Every details of repairs required or defects.
If none enter "In safe working order".
每項修理
如無不足，則註明“處於安全操作狀態”

註明不足，則註明“處於安全操作狀態”

(2)

Load tested (tonnes)

Radius of jib crane

Anchorage tested

Load (tonnes)

Result of test

Every details of repairs required or defects.
If none enter "In safe working order".
每項修理
如無不足，則註明“處於安全操作狀態”

註明不足，則註明“處於安全操作狀態”

(3)

Load tested (tonnes)

Radius of jib crane

Anchorage tested

Load (tonnes)

Result of test

Every details of repairs required or defects.
If none enter "In safe working order".
每項修理
如無不足，則註明“處於安全操作狀態”

註明不足，則註明“處於安全操作狀態”

(4)

Load tested (tonnes)

Radius of jib crane

Anchorage tested

Load (tonnes)

Result of test

Every details of repairs required or defects.
If none enter "In safe working order".
每項修理
如無不足，則註明“處於安全操作狀態”

註明不足，則註明“處於安全操作狀態”

(5)

Load tested (tonnes)

Radius of jib crane

Anchorage tested

Load (tonnes)

Result of test

Every details of repairs required or defects.
If none enter "In safe working order".
每項修理
如無不足，則註明“處於安全操作狀態”

註明不足，則註明“處於安全操作狀態”

(6)

Load tested (tonnes)

Radius of jib crane

Anchorage tested

Load (tonnes)

Result of test

Every details of repairs required or defects.
If none enter "In safe working order".
每項修理
如無不足，則註明“處於安全操作狀態”

註明不足，則註明“處於安全操作狀態”

(7)

Load tested (tonnes)

Radius of jib crane

Anchorage tested

Load (tonnes)

Result of test

Every details of repairs required or defects.
If none enter "In safe working order".
每項修理
如無不足，則註明“處於安全操作狀態”

註明不足，則註明“處於安全操作狀態”

(8)

Load tested (tonnes)

Radius of jib crane

Anchorage tested

Load (tonnes)

Result of test

Every details of repairs required or defects.
If none enter "In safe working order".
每項修理
如無不足，則註明“處於安全操作狀態”

註明不足，則註明“處於安全操作狀態”

(9)

Load tested (tonnes)

Radius of jib crane

Anchorage tested

Load (tonnes)

Result of test

Every details of repairs required or defects.
If none enter "In safe working order".
每項修理
如無不足，則註明“處於安全操作狀態”

註明不足，則註明“處於安全操作狀態”

(10)

Load tested (tonnes)

Radius of jib crane

Anchorage tested

Load (tonnes)

Result of test

Every details of repairs required or defects.
If none enter "In safe working order".
每項修理
如無不足，則註明“處於安全操作狀態”

註明不足，則註明“處於安全操作狀態”

(11)

Load tested (tonnes)

Radius of jib crane

Anchorage tested

Load (tonnes)

Result of test

Every details of repairs required or defects.
If none enter "In safe working order".
每項修理
如無不足，則註明“處於安全操作狀態”

註明不足，則註明“處於安全操作狀態”

(12)

Load tested (tonnes)

Radius of jib crane

Anchorage tested

Load (tonnes)

Result of test

Every details of repairs required or defects.
If none enter "In safe working order".
每項修理
如無不足，則註明“處於安全操作狀態”

註明不足，則註明“處於安全操作狀態”

(13)

Load tested (tonnes)

Radius of jib crane

Anchorage tested

Load (tonnes)

Result of test

Every details of repairs required or defects.
If none enter "In safe working order".
每項修理
如無不足，則註明“處於安全操作狀態”

註明不足，則註明“處於安全操作狀態”

(14)

Load tested (tonnes)

Radius of jib crane

Anchorage tested

Load (tonnes)

Result of test

Every details of repairs required or defects.
If none enter "In safe working order".
每項修理
如無不足，則註明“處於安全操作狀態”

註明不足，則註明“處於安全操作狀態”

(15)

Load tested (tonnes)

Radius of jib crane

Anchorage tested

Load (tonnes)

Result of test

Every details of repairs required or defects.
If none enter "In safe working order".
每項修理
如無不足，則註明“處於安全操作狀態”

註明不足，則註明“處於安全操作狀態”

(16)

Load tested (tonnes)

Radius of jib crane

Anchorage tested

Load (tonnes)

Result of test

Every details of repairs required or defects.
If none enter "In safe working order".
每項修理
如無不足，則註明“處於安全操作狀態”

註明不足，則註明“處於安全操作狀態”

(17)

Load tested (tonnes)

Radius of jib crane

Anchorage tested

Load (tonnes)

Result of test

Every details of repairs required or defects.
If none enter "In safe working order".
每項修理
如無不足，則註明“處於安全操作狀態”

註明不足，則註明“處於安全操作狀態”

(18)

Load tested (tonnes)

Radius of jib crane

Anchorage tested

Load (tonnes)

Result of test

Every details of repairs required or defects.
If none enter "In safe working order".
每項修理
如無不足，則註明“處於安全操作狀態”

註明不足，則註明“處於安全操作狀態”

(19)

Load tested (tonnes)

Radius of jib crane

Anchorage tested

Load (tonnes)

Result of test

Every details of repairs required or defects.
If none enter "In safe working order".
每項修理
如無不足，則註明“處於安全操作狀態”

註明不足，則註明“處於安全操作狀態”

(20)

Load tested (tonnes)

Radius of jib crane

Anchorage tested

Load (tonnes)

Result of test

Every details of repairs required or defects.
If none enter "In safe working order".
每項修理
如無不足，則註明“處於安全操作狀態”

註明不足，則註明“處於安全操作狀態”

(21)

Load tested (tonnes)

Radius of jib crane

Anchorage tested

Load (tonnes)

Result of test

Every details of repairs required or defects.
If none enter "In safe working order".
每項修理
如無不足，則註明“處於安全操作狀態”

註明不足，則註明“處於安全操作狀態”

(22)

Load tested (tonnes)

Radius of jib crane

Anchorage tested

Load (tonnes)

Result of test

Every details of repairs required or defects.
If none enter "In safe working order".
每項修理
如無不足，則註明“處於安全操作狀態”

註明不足，則註明“處於安全操作狀態”

(23)

Load tested (ton

安全措施及設備

- 運作前安全措施
 - 工作簡報會
 - 安全查核表
 - 機件檢查
 - 地下圍封
- 其他設備
 - 帳篷
 - 飲用水
 - 電風扇
 - 梯子…等



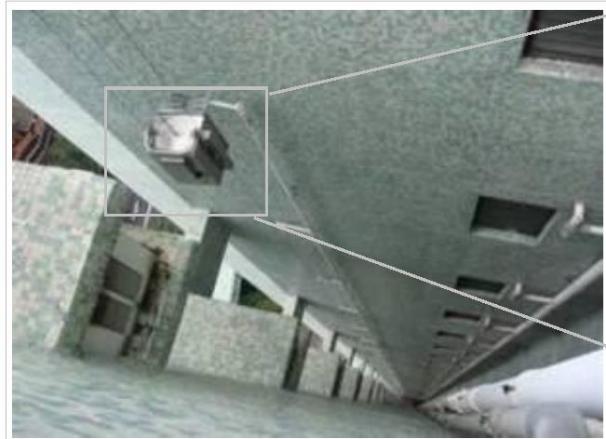
個人防護裝備

- 個人防護裝備
 - 安全帽
 - 安全鞋
 - 安全太陽眼鏡
 - 反光衣
 - 降溫背心
 - 降溫毛巾



實際運作情況

- 立管檢查機械人實際運作情況



收錄影像

- 主動尋找立管隱患



成效(1)

- 工作安全
 - 減低技工於棚架工作上的機會
 - 利用機械人取代高風險工作
 - 減低其他相關的安全問題
 - 高空墮物
 - 保障其他工友及途人
- 公眾安全
 - 加入了立管檢查機械人後，目標樓宇檢查率達100%
 - 主動檢查立管狀況
 - 加速更換已老化的喉管
 - 減少因氣體洩漏而影響客戶



成效(2)

- 提升公司安全形象
 - 提升企業安全形象
 - 減少對客戶造成滋擾
 - 加強客戶信心
- 環保
 - 減少使用竹枝搭建棚架



開拓及發展

- 第二期「立管檢查機械人」研發

更靈活

更輕型

更方便

更穩定



總結

- 主動檢查立管狀況
- 突破傳統，運用科技提升立管檢查的工序
- 代替高空工作，技工只需用電腦控制機械人
- 減少高空工作機會
- 減低工作的危害(人體下墮)及其他有關安全問題
- 增加立管檢查率
- 有效地探測氣體洩漏的情況避免意外發生

謝謝

