

出國報告（出國類別：實習）

進步型沸水式核能電廠  
主蒸汽安全釋壓閥維護及測試技術

服務機關：台灣電力公司 第四核能發電廠

姓名職稱：康力仁 核能工程監

派赴國家：美國

出國期間：95年9月5日至95年9月18日

報告日期：95年11月8日

## 行政院及所屬各機關出國報告提要

出國報告名稱：進步型沸水式核能電廠主蒸汽安全釋壓閥維護及測試技術

頁數 25 含附件：是 否

出國計畫主辦機關/聯絡人/電話：台灣電力公司/陳德隆/02-23667685

出國人員姓名/服務機關/單位/職稱/電話

康力仁/台灣電力公司/第四核能發電廠/核能工程監/02-24902401 ext: 2930

出國類別：1 考察 2 進修 3 研究 4 實習 5 其他

出國期間：95 年 9 月 5 日～95 年 9 月 18 日

出國地區：美國

報告日期：95 年 11 月 8 日

分類號/目：G3/電力工程；G6/機械工程

關鍵詞：SRV、SPVD、Set Pressure、安全釋壓閥、設定壓力、洩漏測試

內容摘要：(二百至三百字)

核能電廠的主蒸汽安全釋壓閥 (MSSRV)，在反應爐運轉期間負責提供反應爐冷卻水壓力邊界過壓之保護，屬核能一級組件。因目前核一、核二之設定壓力測試設備均為十多年前購置之舊式設計，與新式設備之操作有異，故本次派員赴美國兩大主蒸汽安全釋壓閥製造廠參訪測試設備並實習主蒸汽安全釋壓閥之維護及測試技術。

- 本次實習分別赴美國兩大製造廠 Target Rock 及 Crosby，研習內容包括：
- 一、聽取 Target Rock 工廠經理簡報公司沿革與產品介紹；
  - 二、參觀 Target Rock 工廠測試設備；
  - 三、研習 MSSRV 之分解、組裝及檢修技術要領；
  - 四、聽取 Crosby 工廠經理簡報公司沿革與產品介紹；
  - 五、利用光碟影片研習 MSSRV 設定壓力驗證裝置 (SPVD) 之原理與功能；
  - 六、研習 MSSRV 之設定壓力及洩漏測試技術要領。

本文電子檔已傳至出國報告資訊網 (<http://report.nat.gov.tw/work>)

## 目 次

一、目的.....	1
二、過程.....	2
三、心得.....	23
四、建議事項.....	25
附錄.....	26

## 一、目的

核四廠之主蒸汽管路共有 18 只主蒸汽安全釋壓閥 (MSSRV) 為反應爐冷卻水壓力邊界的一部份，屬核能一級 (ASME Class I) 組件，在電廠正常運轉期間並負責提供反應爐過壓之保護，而當反應爐保護系統動作時，其中 8 只 MSSRV 的自動洩壓 (ADS) 功能，必須能克服彈簧力自動將 MSSRV 打開使反應爐降壓，故其維護品質之良窳，直接影響反應爐運轉安全。

核四廠對安全釋壓閥之維護策略為，建立一套專用的洩漏測試設備，於大修前即對所有 MSSRV 進行檢修與測試，既可確保設備可靠度，亦能縮短現場維修測試時程。

因目前核一、核二之設定壓力測試設備均為十多年前購置之舊式設計，與新式設備之操作有異，故本次派員赴美國兩大製造廠實地參訪測試設備並研習 MSSRV 之維護及測試技術，期能瞭解 MSSRV 之維護技術要領及專用洩漏測試設備之特性與操作設定，有效提升設備可靠度與維護品質，確保反應爐運轉安全。

## 二、過程

### (一) 出國行程

本次出國，先抵達美國紐約，赴核四廠 MSSRV 製造廠家 Target Rock 公司（該公司已於 1997 年改名為 Curtiss-Wright Flow Control Corporation）參訪研習，研習內容包括：

1. 聽取 Target Rock 工廠經理簡報公司沿革與產品介紹；
2. 參觀 Target Rock 工廠測試設備；
3. 研習 MSSRV 之分解、組裝及檢修技術要領。

第二週前往麻州波士頓，赴核一、二廠 MSSRV 製造廠家 Crosby 公司（該公司已於 1998 年被 Tyco International, Inc. 收購）參訪研習，該公司也是設計與製造核一、二廠 MSSRV 測試設備的廠家，研習內容包括：

1. 聽取 Crosby 工廠經理簡報公司沿革與產品介紹；
2. 利用光碟影片研習 MSSRV 設定壓力驗證裝置（SPVD）之原理與功能；
3. 研習 MSSRV 之設定壓力及洩漏測試技術要領。

本次出國行程如下表：

起始日	迄止日	前往 機構名稱	國家城市 名稱	詳細工作內容
950905	950906			往程（台北→洛杉磯→紐約）
950907	950909	Target Rock 公司	美國 紐約	實習主蒸汽安全釋壓閥維護及測試
950910	950910			路程（紐約→波士頓）
950911	950915	Crosby 公司	美國 波士頓	實習主蒸汽安全釋壓閥維護及測試
950916	950918			路程（波士頓→紐約→洛杉磯→台北）

## (二) 研習內容

### 1. Target Rock 公司沿革與近況介紹：

- (1) Target Rock 公司歷史：Target Rock 成立於 1951 年，原名為 Target Rock Corporation，為紀念其創辦人，在 1997 年正式改名為 Curtiss-Wright Flow Control Corporation 並擴大業務範圍，原來的 Target Rock 工廠舊址則變成 Target Rock Division。1998 年併購 Enertech 公司，1999 年併購 Farris Engineering 公司，2001 年併購 Solent & Pratt 公司，2002 年併購西屋公司所屬的 Electro-Mechanical Division (EMD) 至今。請參閱附錄 A。
- (2) 其他資訊：包括生產線與產品種類、主要製造廠與分工廠、員工人數與持照人員、製造與安裝經驗、法規證照種類、設計分析能力與財務狀況等，請參閱附錄 A。

### 2. Target Rock 公司產品介紹：

- (1) 直接驅動之電磁操作隔離閥 (Direct-Acting Solenoid Operated Isolation Valve)：包括設計特性、引動技術、運轉操作及基本資料等，請參閱附錄 B。
- (2) 主蒸汽安全釋壓閥 (Main Steam Safety Relief Valve)：設計特性包括以杯形彈簧墊圈 (Bellville Spring Stack) 取代傳統的螺旋形彈簧、硬化處理的螺紋式進口噴嘴 (**Threaded Nozzle**) 座面、閥盤採用 FLEX-C DISK 設計，及經完整驗證的空氣驅動器等，請參閱附錄 B。

### 3. Target Rock 工廠測試設備參觀：

參觀 MSSRV 測試設備的完整流程與迴路，包括測試座之進、出口法蘭、進口蒸汽之大型及小型蓄壓器、蒸汽出口管路與閥門、升溫升壓控制閥、排氣端限流孔尺寸測定裝置、環境溫度控制箱、鍋爐、測試紀錄控制儀表與盤面，及屋外大型冷卻水塔、冷卻水泵與管路等，相關照片請參閱附錄 C。

#### 4. MSSRV 之分解、組裝及檢修技術：

以下步驟中所標示之零件號碼請參閱附圖 01。

##### (1) MSSRV 拆解：

1.1 拆除電氣快速接頭 (147)，拆除位置指示器。

1.2 拆除手動桿組件及相關聯動組件：

1.2.1 鬆開垂片墊圈 (75)，拆除閘桿固定螺帽 (54)、垂片墊圈 (75) 和凸輪 (134)，量測並記錄手動桿組件 (45) 凸輪面與針狀滾子軸承 (69) 之“歸零間隙 (Zero Clearance)”，以成為回裝時再量測之依據 (參考附圖 02)。

1.2.2 1.2.2 鬆開軸承承座襯套 (Bearing Carrier Bushing, 55) 及軸承螺帽 (53)，由閘桿 (38) 拆除軸承承座襯套 (55) 之滾子軸承各組件，如軸承承座 (Bearing Carrier, 52)、軸承螺帽 (53)、2 支彈簧銷 (89)、針狀滾子軸承 (Needle Bearing, 13)、針狀滾子軸承 (69)、間隔環 (Ring, 118)、環夾 (Circlip, 126)。

1.2.3 1.2.3 由軸承承座 (52) 拆下 2 只環夾 (126)、2 只針狀滾子軸承 (13)、2 只間隔環 (118)、2 只針狀滾子軸承 (69)。

1.2.4 1.2.4 取出固定手動桿組件 (45) 與連接軸 (57) 之彈簧插銷 (14)，拆除 2 只環夾 (70)，支撐好手動桿組件 (45)，推出連接軸 (57) 使手動桿 (45) 脫離驅動器連接環 (Connection Piece, 51)，拆除針狀滾子軸承 (13) 與 2 只間隔環 (76)。

1.2.5 1.2.5 由閘罩 (Bonnet, 20) 拆除 4 只內六角螺栓 (98) 和 12 只內六角螺栓 (99) 與 16 個閉鎖墊圈 (87)，拆開固定座 (136) 與兩固定板 (100)，拆除兩耐磨板 (101)，確定耐磨板已被拆除並保留在閘罩上。

1.2.6 1.2.6 拆除 2 只環夾 (12)，支撐好手動桿組件 (45)，推出軸 (56)，拆除手動桿組件 (45) 與 2 片墊片 (Shims, 125)。

1.3 拆除氣動驅動器和電磁控制閘等組件：

1.3.1 由電磁閘上拆除電線接頭 (146)，拆下 1<sup>1</sup>/<sub>4</sub>”法蘭及拆除壓縮空氣供應管線。

1.3.2 利用維修室吊車與尼龍吊索吊住電磁閘控制閘組件，拆除內六角螺絲 (114 或 141) 與閉鎖墊圈 (115&87)，由驅動氣缸 (77) 拆除電磁閘控制閘組件。

1.3.3 拆下 4 組螺樁 (102) 上之螺帽 (10) 與閉鎖墊圈 (104)，由閘罩

(20) 下部拆除氣動驅動缸 (77)，再由螺樁 (102) 拆下固定墊片 (140)。

#### 1.4 拆除閥罩及閥內細部組件：

- 1.4.1 由閥罩 (20) 及微排汽管 (106)，鬆開並拆除六角頭螺栓 (124) 與閉鎖墊圈 (115)，拆除閉鎖裝置 (123)。
- 1.4.2 鬆開並拆除微排汽管 (106) 和其細部組件，如螺帽 (90)、螺樁 (105)、法蘭 (107)、法蘭 (108)、流孔板 (131)、溝槽插銷 (132) 及密合墊 (109)。
- 1.4.3 安裝油壓千斤頂於閥罩上方，先將千斤頂支撐板由閥桿 (38) 上端套入閥桿，兩固定板 (100) 回裝在閥罩上方之閥軛兩側，將油壓千斤頂由閥桿 (38) 上端套入閥桿置於支撐板上，將內牙連接棒 (Connecting Rod) 穿越油壓千斤頂之中空塞孔而鎖接閥桿，連接棒螺牙鎖入閥桿約  $1\frac{1}{2}$ "，且鎖接後必須注意確認由千斤頂之中空塞上面至連接棒肩部間隔距離在  $1\frac{3}{4}$ "~ $2\frac{1}{2}$ " 間，此為千斤頂壓力移除後使彈簧釋壓之限制最小高度 (即拆除工作完成後，千斤頂釋壓收回行程使彈簧釋壓完全後，千斤頂仍有多餘空間縮回行程，在完全無被夾緊之情況下易鬆開連接棒，取出千斤頂)。
- 1.4.4 緩慢加壓千斤頂，使閥桿升高大約  $\frac{1}{4}$ "，如此將提起閥盤使閥盤脫離閥座，當閥罩與閥體之固定內六角螺絲 (78) 鬆解時，可避免閥罩因彈簧組件作用力而被舉起。
- 1.4.5 剪斷並拆下固定 18 只內六角螺絲 (78) 之安全鐵絲，並拆除 18 只內六角螺絲 (78)，穿越閥罩法蘭鎖入 2 只直徑 1"、長度  $6\frac{1}{2}$ "、一端牙規格為 1"-8 UNC (牙長約 1") 之長棒到閥體兩對應螺孔使成為引導棒，作為吊升閥罩及閥內部組件時之導引，以避免移除閥罩及閥內部組件時因閥體頸部之沖放環 (30) 而造成傷害。
- 1.4.6 利用暫先回裝閥罩上方兩固定板 (100)，在兩固定板上方吊耳孔裝上吊環與吊鎖，以維修室吊車由此緩慢的吊起閥罩，此時閥罩連同閥內部組件將可垂直完整被拔出。
- 1.4.7 當拔出閥罩連同閥內部組件，在顯露出沖放環 (30) 時，在沖放環 (30) 與襯板 (28) 作一暫時的記號，以利回裝。
- 1.4.8 繼續吊升閥罩 (20) 並小心的導引其內部組件以防碰撞損壞，直到完全脫離閥體。
- 1.4.9 由閥桿 (38) 上鬆開主閥盤組件 (21)，小心勿損害到座面。
- 1.4.10 降下閥罩連同閥內部組件到一乾淨之工作面，直到閥塞 (Piston, 27) 或沖放環 (30) 支撐整組件，注意勿讓閥桿下部尖端接觸工作面，且準備好支撐勿使閥罩傾倒。

- 1.4.11 緩慢地將千斤頂釋壓直到千斤頂活塞完全縮回，因受彈簧復原至原負載狀態長度之影響，閥罩（20）因此將逐漸升起，拆除連接棒，由閥桿（38）拆除油壓千斤頂及千斤頂支撐板。
- 1.4.12 由4個彈簧壓縮內六角螺絲（81）拆除安全鐵絲（68），均勻的鬆開並拆除4個內六角螺絲（81），此時閥罩將下降至接觸襯板（28），拆下4個墊圈（88），閥蓋（40），4個分裂調整套（44），與套筒（39）。
- 1.4.13 以維修室吊車吊起閥罩，使其與閥桿（38）及其它內部組件分離。
- 1.4.14 使用一塊附有吊耳的鋼板，鎖裝於彈簧閉鎖螺帽頂面，以吊車與尼龍吊索將彈簧組件（58）吊離閥桿（38）。
- 1.4.15 小心將閥塞（27）及閥桿（38）滑離襯板組件（Liner Assembly, 28），記錄由襯板（28）拆下沖放環（30）時鬆轉之圈數，以利將來回裝時之參考。
- 1.4.16 由閥體（18）拆除2只用於拆除閥罩時所用之引導棒，及拆除閥體上端凹面之密合墊（71）。
- 1.4.17 在閥體內之噴嘴環（Nozzle Adjusting Ring, 29）與噴嘴（Nozzle, 19）上作一記號，拆除安全鐵絲（68）及8只內六角螺絲（80），拆下調整螺栓（36及37）。
- 1.4.18 由噴嘴座（Nozzle Seat, 19）鬆轉拆除噴嘴環（29），在鬆轉拆除時應記錄下鬆轉圈數以利爾後回裝，如有必要由閥體拆下噴嘴座（19）。
- 1.4.19 如必要將閥桿（38）閥塞（27）分離，則鬆開垂片墊圈（83）與閥桿螺帽（31），退出閥桿螺帽約1/2"，將閥塞（27）上推至閥桿螺帽（31）拆除2半片之閥桿軸環（Collar, 32），拆除閥塞（27），垂片墊圈（83）與閥桿螺帽（31），拆除時勿刮傷螺桿。
- 1.4.20 均勻的鬆開4個格蘭固定螺栓（82）以釋放杯形彈簧墊圈（Belleville Disc Spring, 129）的彈力，由格蘭蓋（33）中拆除螺栓（82）、襯套（Bushings, 128）、杯形彈簧墊圈（129）、與格蘭（35）。
- 1.4.21 由螺樁（79）鬆開並拆除8只垂片墊圈（84）、螺帽（90），由襯板（28）拆除格蘭蓋（33）密合墊（73），由格蘭蓋（33）拆除迫緊環（Packing Ring, 74）與導套（Guide Bushing, 34）。
- 1.5 拆解位置指示組件。
- 1.6 氣動驅動器之拆解：
  - 1.6.1 支撐氣動驅動器末端蓋（Rear Cap, 6），使活塞桿（Piston Bar）在

垂直位置。

- 1.6.2 摺直以鬆開垂片墊圈 (117)，鬆開螺帽 (112)，由驅動器心軸轉鬆連接環 (Connecting Piece, 51)，拆除垂片墊圈 (117) 及螺帽 (112)。
- 1.6.3 壓緊或夾緊驅動器蓋 (Head, 5)，以防止驅動器蓋 (5) 受彈簧復歸彈力撐開。
- 1.6.4 小心拆開繫棒 (Tie Rod, 3) 上之螺帽 (15)。
- 1.6.5 緩慢的釋放驅動器蓋 (5) 之彈力，由活塞桿 (4) 滑出驅動蓋與軸承 (7) 組件，由驅動蓋 (5) 拆下軸承。
- 1.6.6 由氣缸管 (Tube, 2) 內拆除彈簧導件 (9)、彈簧 (13) 及活塞 (12)。
- 1.6.7 將氣缸管 (Tube, 2) 與末端蓋 (6) 分離。
- 1.6.8 由彈簧導件 (9) 拆下減震墊 (Cushion Seal, 17)。
- 1.6.9 由活塞 (12) 拆下耐磨帶 (11)，V 形活塞封環 (8)。
- 1.6.10 由驅動器蓋 (5) 與末端蓋 (6) 拆除氣缸封環，由末端蓋 (6) 拆下平頭螺絲與緩衝器 (Bumper, 14)。
- 1.7 拆解電磁控制閥。
- 1.8 拆解壓縮空氣放大器。

## (2) MSSRV 之檢查：

- 1.1 檢查所有組件狀態，檢查是否有裂縫、損壞、扭曲等現象，具有螺牙之組件是否崩牙或其他損壞現象。
- 1.2 檢查 O 形環是否損壞，若損壞表示之前之安裝不正確。
- 1.3 檢查所有保護塗裝表面，其裸露處是否銹蝕。
- 1.4 檢查所有殼或蓋是否有刮痕、刻痕、凹陷、裂縫。
- 1.5 檢查所有組件銘牌是否牢堅固。
- 1.6 檢查所有通道和孔口是否阻塞。
- 1.7 檢查所有的軸或桿是否正直，有無毛邊和不光滑處。
- 1.8 檢查所有間隔環、套筒和類似組件在配合面是否有粗糙等瑕疵，如裂痕、異常的磨耗和其他損壞。

1.9 檢查噴嘴座面及閥盤座面無工具刮痕及凹陷，其密合帶（Seating Band）是乾淨、平滑、無損壞。

1.10 檢查噴嘴座（19）、閥桿（38）、閥罩（20）、閥盤（21）與閥體（18），其內外表面是否有裂縫、裂痕、與變形，若其中有組件被發現損壞，則上述組件皆以 PT 檢查以判定可用與否。

1.11 目視檢查所有組件是否有損壞之跡象，如果一零件或一組件被發現即將損壞，則應再檢查周遭相關或對應組件。

1.12 檢查銘牌字跡是否清楚。

### (3) MSSRV 回裝：

#### 1.1 襯板回裝：

1.1.1 將密合墊（73）放置於襯板（28）頂部凹環面。

1.1.2 將格蘭蓋（33）、垂片墊圈（84）與螺帽（90）套上 8 只螺樁（79）裝於襯板（28）頂部，以 70~75 ft-lb 之扭矩鎖緊螺帽（90），此時格蘭蓋（33）與襯板（28）應完全接觸無間隙，若有間隙，則必要升高螺帽（90）之鎖緊扭矩使格蘭蓋（33）與襯板（28）完全接觸，再回復到適當扭矩，完成鎖緊步驟後，彎曲垂片墊圈（84）以閉鎖固定螺帽。

1.1.3 將導套（34）裝入格蘭蓋（33）直到深入底座。

1.1.4 將格蘭迫緊環（74）裝入格蘭蓋（33）直到接觸導套（34），裝上格蘭（35）但暫不壓緊。

1.1.5 將格蘭（35）上 4 個螺栓孔對正格蘭蓋（33），裝上 1 只螺栓（82）與 1 只襯套（128），並於襯套（128）內部 4 個孔中裝上 4 個杯形彈簧墊圈（129），暫不鎖緊螺栓，須等閥桿（38）安裝後方可鎖緊螺帽。

#### 1.2 閥桿與閥塞回裝：

1.2.1 小心的將垂片墊圈（83）裝於閥桿（38）上的溝槽，安裝時應注意勿刮傷閥桿與格蘭迫緊環（74）之接觸面。

1.2.2 將閥桿螺帽（31）裝於閥桿（38），鎖緊方向旋轉約兩圈。

1.2.3 以閥桿（38）下端由閥塞（27）頂部穿過閥塞中心孔，將兩半的軸環（32）裝入閥桿（38）之環溝，將閥桿桿上拉以抵住閥塞孔，鎖緊閥塞孔上端之閥桿螺帽（31），此時垂片墊圈（83）完全貼平閥塞（27），閥桿與閥塞（27）間無法軸向移動。

1.2.4 檢查閥桿（38）與閥塞（27）外徑之偏心度，校正時鬆開閥桿螺

帽 (31)，調整使閥桿 (38) 與閥塞 (27) 同心後再鎖緊閥桿螺帽 (31)，鎖緊閥桿螺帽後彎曲垂片墊圈 (83) 將閥桿螺帽 (31) 固定於閥桿 (38)，再檢查一次同心度。

### 1.3 閥罩回裝：

- 1.3.1 將閥塞 (38) 下部表面放置於一個乾淨且平坦不會損傷閥塞表面之工作平面，使閥桿 (38) 及閥塞整組可垂直的置放，此時應再度確認閥桿下端不會接觸工作平面。
- 1.3.2 將沖放環 (30) 依照之前拆解時所記錄的圈數回鎖於襯板 (28)。
- 1.3.3 將襯板 (28) 組件套入閥桿 (38) 與閥塞 (27) 組件直到襯板 (28) 接觸到工作面，套入時應小心，避免閥桿傷及襯套內部格蘭迫緊環 (74)。
- 1.3.4 將 4 只格蘭螺栓 (82) 依對角順序方式均勻依扭矩 80~90 ft-lb 鎖緊，使格蘭迫緊環 (74) 緊抵閥桿成形 (38) 後，再放鬆 4 只格蘭螺栓 (82) 到手緊程度。
- 1.3.5 將套於格蘭迫緊環 (74) 內的閥桿轉動與軸向移動。
- 1.3.6 重覆 6.7.3.4 節與 6.7.3.5 節動作。
- 1.3.7 均勻的鎖緊格蘭螺栓 (82) 直到 4 只襯套 (128) 與格蘭 (35) 之間隙為 0.060”~0.062”間，確實的以安全鐵絲固定螺栓。
- 1.3.8 吊起主彈簧組件 (58)，緩緩將其套入閥桿 (38)，並支撐固定妥當以防止其在後續組裝時掉落。
- 1.3.9 將套筒 (39) 斜面向下套入閥桿 (38) 直到接觸主彈簧組件 (58)。
- 1.3.10 小心的將閥罩 (20) 吊起並套入閥桿 (38)、彈簧 (58) 與襯板 (28)，直到引導閥罩之直徑正確的對齊襯板 (28)，檢查閥罩之微排汽管 (106) 開孔與襯板 (28) 微排汽管 (106) 接口之方向，是否可順利安裝微排汽管 (106)。
- 1.3.11 將閥蓋 (40) 套入閥桿 (38) 放於套筒 (39) 上，將 4 只內六角螺絲 (81) 與墊圈 (88) 穿過閥蓋並鎖進閥罩 (20)，鎖緊直到內六角螺絲頭接觸墊圈 (88)。
- 1.3.12 先裝上一片分裂調整套 (44) 圍住內六角螺絲 (81)，繫緊安全鐵絲。
- 1.3.13 安裝千斤頂支撐板，由閥桿套入直到座住兩固定板 (100) 間閥罩 (20) 閥軛之頂部，將千斤頂套入閥桿裝於支撐板上，調整支撐板和千斤頂使閥桿處於中心，由千斤頂之中空塞插入含內螺牙之連接棒至接觸閥桿 (38)，將連接棒套上螺桿鎖入約 1<sup>1</sup>/<sub>2</sub>”，且鎖接

後必須注意預留千斤頂之中空塞回程間隙，此間隙即是千斤頂之中空塞上面至連接棒肩部之間隔距離，在 1”~2”之間。

#### 1.4 閥體回裝：

- 1.4.1 將噴嘴閥座（19）之螺牙與法蘭面塗抹潤滑劑並鎖入閥體，其鎖緊扭矩 1750 ft-lb。
- 1.4.2 將閥體裝於組裝支撐固定架內。
- 1.4.3 鎖上噴嘴環（29）在噴嘴閥座（19），依拆解時所記錄之圈數回裝。
- 1.4.4 將密合墊（71）置放於閥體頂面之凹槽處，並鎖上 2 只閥罩引導棒於對稱位置。
- 1.4.5 將微排汽管（106）由閥罩（20）開孔裝入鎖於襯板（28），暫先以手鎖緊。
- 1.4.6 吊起閥罩包含內部組件及油壓千斤頂，均勻的鎖緊內六角螺絲（81），鎖緊扭矩為 300~320 ft-lb。
- 1.4.7 小心在閥桿（38）的末端鎖裝閥盤組件（21），鎖緊直到聽到“卡答”聲響，再順時針旋轉閥盤 1/2 圈。
- 1.4.8 檢查閥盤與噴嘴閥座（19）之表面是清潔的，緩慢增加油壓千斤頂直到閥桿升起約 1 英吋。
- 1.4.9 小心的將閥罩（20）組件套入引導棒進入閥體（18），使微排汽管（106）對準閥體出口，檢查閥罩（20）、襯板（28）、閥體（18）皆已對正，且法蘭面皆平行，此工作進行時應勿損壞到密合墊（71）。
- 1.4.10 拆除閥罩引導棒與微排汽管（106）。
- 1.4.11 安裝 18 支內六角螺絲（78）將閥罩與閥體固定，均勻的依對角方向順序逐漸的增加扭矩鎖緊，直到所有螺絲扭矩達 300~320 ft-lb，閥體與閥罩應完全密合無間隙，若鎖緊達標準扭矩值後閥罩與閥體仍無密合，則增加扭矩直到閥罩與閥體鎖緊密合，並更正原訂扭矩值為新建立扭矩值，並記錄之。
- 1.4.12 緩慢的釋放油壓千斤頂壓力直到閥盤（21）逐漸的接觸閥座（19）後，拆除千斤頂及相關附件。
- 1.4.13 以安全鐵絲固定內六角螺絲（78）。
- 1.4.14 組裝微排汽管（106）、法蘭（107）、流孔板（131）與插銷（132）等相關組件，以法蘭（107）內徑曲面接合微排汽管（106）後端曲面環，將密合墊（109）套入微排氣管螺牙端並置放於肩部。

- 1.4.15 將微排汽管（106）穿越閥罩開孔進入襯板（28），用手將微排汽管（106）鎖入襯套至壓迫密合墊，以扭矩 300~320 ft-lb 鎖緊微排汽管，將閉鎖裝置（123）裝於微排汽管（106），並用螺栓（124）及閉鎖墊圈（115）將閉鎖裝置固定於閥罩，以確保微排汽管之位置。
  - 1.4.16 將法蘭（108），密合墊（110），螺樁（105）與六角螺帽（90）裝於微排氣管法蘭（107），勿鎖緊。
  - 1.4.17 將調整螺栓（36）與（37）和密合墊（72）裝入閥體，以接合與閉鎖噴嘴環（28）和沖放環（30）於先前之位置，用 8 只（每組 4 只）內六角螺絲（80）確實的固定調整螺栓（36）與（37），正常狀況下內六角螺絲（80）之鎖緊扭矩為 23~25 ft-lb，調整螺栓必須接觸閥體，若調整螺栓仍未接觸閥體，則增加內六角螺絲（80）扭矩值直到調整螺栓（36）與（37）接觸閥體，並記錄新建立之扭矩值。
  - 1.4.18 完成所有之調整後，用安全鐵絲固定內六角螺絲（80）與彈簧調整內六角螺絲（81）。
- 1.5 氣動驅動器各組件回裝：
- 1.5.1 使用潤滑劑 Parker Super-O-Lube（16）微微塗於氣缸減震墊（17），在驅動器蓋（5）與末端蓋（6）裝上氣缸封環。
  - 1.5.2 小心的用扁平鈍頭工具將活塞封環（8）裝於活塞（12）之溝槽內，注意勿讓封環扭轉或損壞，裝上時每一活塞封環（8）之唇部應面向外。
  - 1.5.3 安裝耐磨帶（11）於活塞（12）的寬槽上。
  - 1.5.4 將少許粉狀的藍色 Loctite 潤滑劑（18）塗抹於軸承封環組件之螺牙（7）之螺牙，將此軸承封環組件鎖入氣缸之驅動器蓋（5），稍微鎖緊即可固定軸承。
  - 1.5.5 潤滑減震墊（17）後，裝於彈簧導件（9）之溝槽內。
  - 1.5.6 使用平頭螺絲鎖緊緩衝器（Bumper, 14）於末端蓋（6）。
  - 1.5.7 在氣缸管（2）內部、活塞、軸承（7）、V 形活塞封環（8）微塗上一層潤滑劑。
  - 1.5.8 將活塞（12）與活塞桿組件（4）小心的插入氣缸管（2），使用用扁平鈍頭工具協助引導封環進入氣缸管（2），插入時應小心勿傷到封環。
  - 1.5.9 將氣缸管（2）接合裝於末端蓋（6）溝槽內之封環（16）。

- 1.5.10 將彈簧（13）與彈簧導件（9）套入活塞棒（4）。
- 1.5.11 小心的將驅動器蓋（5）一邊調整一邊套入活塞桿（4）與氣缸管（2），繫好活塞桿（4）、氣缸管（2）、繫棒（3）。
- 1.5.12 使用一個夾具，緩慢的夾緊驅動器蓋（5）以壓縮彈簧至接合氣缸管（2），維持氣缸管（2）及繫棒（3）之對準，直到頭端蓋溝槽內之封環（16）接合氣缸管（2）。
- 1.5.13 使用粉狀的藍色 Loctite 潤滑劑塗抹於繫棒（3）螺牙，將螺帽（15）裝於結合棒，均勻的以 175 ft-lb 扭矩鎖緊螺帽（15），緩慢的釋放臨時夾具的力量。
- 1.6 回裝電磁閥組件。
- 1.7 回裝氣體放大器（Pneumatic Amplifier）。
- 1.8 回裝位置指示器。
- 1.9 驅動器與電磁閥組件裝於閥罩：
  - 1.9.1 將螺帽（112）垂片墊圈（117）與連接環（51）裝於驅動器之活塞桿（4）上，暫勿鎖緊。
  - 1.9.2 將驅動器之 2 片固定墊片（140）裝於閥罩（20）之驅動器固定螺樁（102）上。
  - 1.9.3 使用吊索繫於連接環（51），以吊車吊起驅動器與電磁閥組件，使其螺樁孔對正閥罩上驅動器固定法蘭之螺樁，裝上組件直到其接觸 2 片固定墊片（140）。
  - 1.9.4 裝上 4 只閉鎖墊圈（104）和螺帽（103）於螺樁（102）上適當的鎖緊，但勿施以扭矩鎖緊。
  - 1.9.5 移除吊具及吊車。
  - 1.9.6 均勻的鎖緊 4 個驅動器固定螺帽（103），其鎖緊扭矩為 80-90 ft-lb。
- 1.10 安裝手動桿與聯動組件：
  - 1.10.1 將手動桿（45）延伸部位背向閥出口而套入閥桿（38）。
  - 1.10.2 以潤滑劑潤滑墊片（125）閥罩和推出軸（56）推出軸軸套（47）。
  - 1.10.3 安裝墊片（125）於手動桿（45）之兩側外面介於閥罩（20）間。
  - 1.10.4 將推出軸（56）穿過閥罩上的推出軸軸套（47）、墊片（125）、手動桿（45）。

- 1.10.5 在軸兩端溝槽內裝上環夾（12），以確實固定推出軸（56）。
- 1.10.6 支撐好手動桿（45）使其推力端軸孔中心對正連接環（51）之環孔中心。
- 1.10.7 調整驅動器活塞桿上的連接環（51），使手動桿（45）下方加工平面至閥罩(20)頂部加工平面間之距離大約為4英吋(參考附圖4)。
- 1.10.8 旋緊螺帽（112）以固定連接環（51），並確實的將垂片墊圈（117）彎曲以固定螺帽（112）。
- 1.10.9 使用潤滑油脂潤滑針狀滾子軸承（13），使用潤滑劑潤滑間隔環（76）及連接軸（57）。
- 1.10.10 將針狀滾子軸承（13）裝入連接環（51）之軸承孔內，將間隔環（76）裝於滾子軸承（13）兩側。
- 1.10.11 降下手動桿（45）套於連接環（51）、針狀滾子軸承（13）、間隔環（76）上，將手動桿（45）、針狀滾子軸承（13）、間隔環（76）所有連接軸孔對正。
- 1.10.12 將連接軸（57）插銷孔與手動桿（45）之插銷孔位置對應後，將連接軸（57）貫穿手動桿（45）、針狀滾子軸承（13）、間隔環（76）以連結上述各組件。
- 1.10.13 連接軸（57）貫穿連結各組件後將兩測溝槽中裝入環夾（70）。
- 1.10.14 將插銷（14）插入手動桿（45）貫穿連接軸（57）以固定閉鎖整組件。
- 1.10.15 以吊車吊掛上提手動桿（45）使驅動器活塞桿伸出全行程，吊車緩緩降下手動桿（45）以減少吊升力量，使驅動器可藉彈簧之力量完全縮回活塞桿，確認活塞桿（4）無被束縛不順現象。
- 1.10.16 若活塞桿有被束縛不順現象，則表示組裝排列有誤，應檢查修正。
- 1.11 滾子軸承回裝：
  - 1.11.1 使用潤滑油脂潤滑軸承（13及69），將針狀滾子軸承（69）各別裝入軸承承座（52）較大直徑處之兩側。
  - 1.11.2 將間隔環（118）與軸承（13）裝於軸承承座（52）較小直徑處之兩側。
  - 1.11.3 在軸承承座（52）小直徑處之最外兩側溝槽上裝上環夾（126）。
  - 1.11.4 將軸承承座襯套（55）由軸承承座（52）頂部裝入，將螺帽（53）由軸承承座襯套（55）下方鎖上，直到螺帽插銷孔對正軸承承座

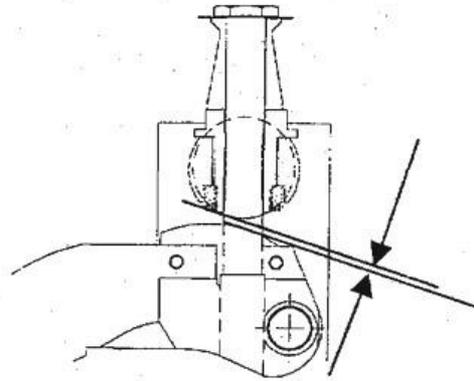
襯套插銷孔後，插入兩彈簧插銷，此時應確認軸承承座襯套（55）與軸承承座（52）間可相對轉動，且彈簧插銷安裝後不能突出軸承承座襯套內徑。

#### 1.12 軸承組件回裝：

- 1.12.1 將兩耐磨板（101）裝配於閥罩（20）上端凹入區域。
  - 1.12.2 將兩固定板（100）裝於閥罩（20）兩側蓋住耐磨板（101），固定板之吊耳孔應偏向驅動器方向。
  - 1.12.3 將4組內六角螺絲（99）與閉鎖墊圈（87），由每一固定板（100）較低處螺孔穿越固定板鎖於閥罩，暫以手鎖緊內六角螺絲（99）。
  - 1.12.4 將位置指示器之托架（136）跨過兩固定板（100）而安裝，先對正螺絲孔後，以2組內六角螺絲（98）與閉鎖墊圈（87），穿越托架（136）鎖於固定板（100）與耐磨板（101），暫以手鎖緊內六角螺絲（98）。
  - 1.12.5 將剩於4組內六角螺絲（99）與閉鎖墊圈（87），穿越托架（136）鎖於固定板（100）。
  - 1.12.6 將耐磨板（101）裝於驅動器水平之反方向使其緊靠閥罩支撐面，均勻的鎖緊16只內六角螺絲（98）與（99），螺絲鎖緊後確認耐磨板堅固的緊靠閥罩面。
  - 1.12.7 將整軸承組件「裝於軸承承座之所有組件，含軸承（13，69）、軸承承座襯套（55）等」，藉由軸承承座襯套（55）內之螺牙旋入閥桿（38），直到針狀滾子軸承（69）與手動桿（45）凸輪之間隙“歸零間隙”等於拆解前之記錄值，並確認針狀滾子軸承（13）不會壓緊耐磨板（101）。
  - 1.12.8 將位置指示器驅動凸輪（134）大端直徑朝向軸承承座襯套（55）裝於閥桿（38）。
  - 1.12.9 裝上垂片墊圈（75）與固定螺帽（54），鎖緊螺帽（54）以固定驅動凸輪（134）與軸承承座襯套（55），等整組 MSSRV 初步的測試與調整後方可將垂片墊圈（75）彎曲閉鎖。
- 1.13 回裝位置指示器。

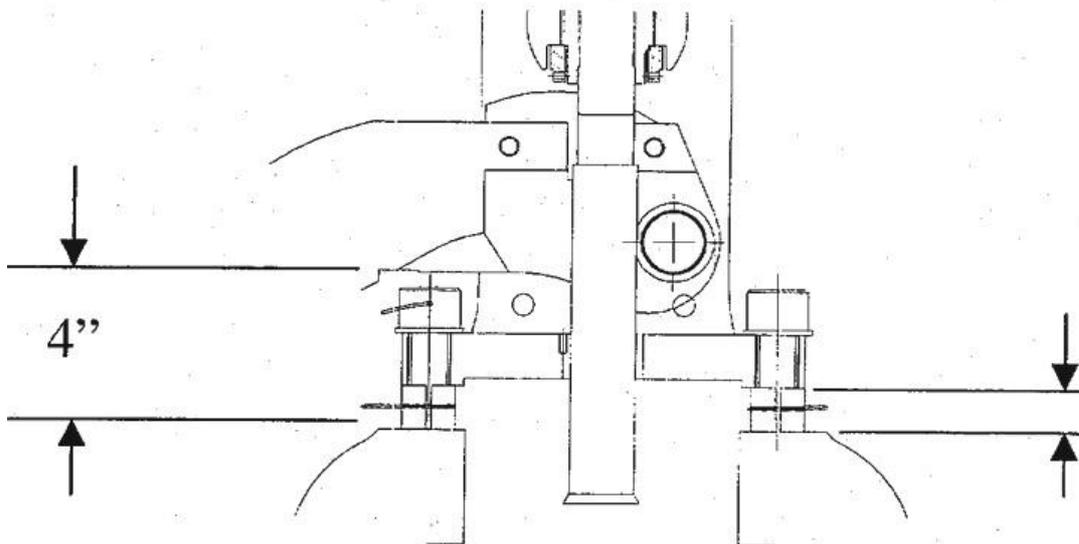


附圖 02 歸零間隙與手動桿調整及分裂調整套高度示意圖



ZERO CLEARANCE

ACTUATOR ADJUSTMENT AND HEIGHT OF SPLIT BUSHINGS



## 5. Tyco International, Inc. 公司沿革與近況介紹：

(1) Tyco International, Inc. 的業務經營範圍區分為電子元件、工程產品與服務、防火，及保健四大區塊。而總公司以下分為工程產品與防火部、電子元件部與保健部三大部門。其工程產品與防火部之業務包括電氣與金屬產品、防火與建材、流量控制、公共建設服務與熱力控制等。其中與核能相關部門為流量控制，該部門已創立超過 80 種品牌，較有名的如：CROSBY、ANDERSON GREENWOOD、MORIN、VANESSA、KEYSTONE、SEMPELL、SAPAG、YARWAY、DESCOTE、INTERVALVE、GIMPEL、RAIMONDI 等。

(2) Crosby 公司歷史：Crosby Steam Gage & Valve 公司成立於 1874 年，並於 1920 年研發出第一個彈簧負載式安全閥。1945 年被 Stone 家族收購，1981 年被 Geosource 公司收購，1984 年被 Moorco 公司收購，1993 年 Crosby Valve 新加坡分公司成立，1995 年 Moorco 公司被 FMC 公司併購，1998 年 Tyco International, Inc. 再收購 FMC 公司的 Crosby 部門至今。

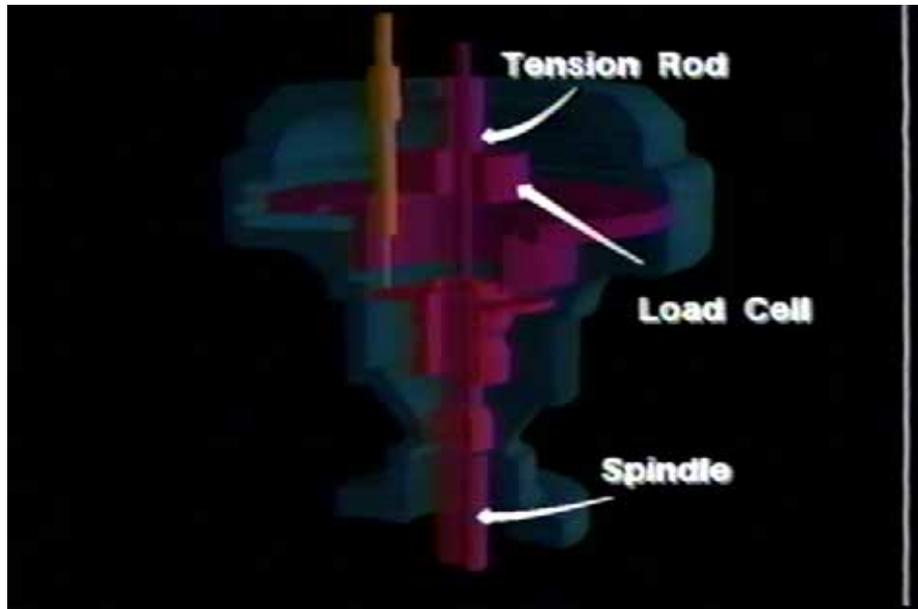
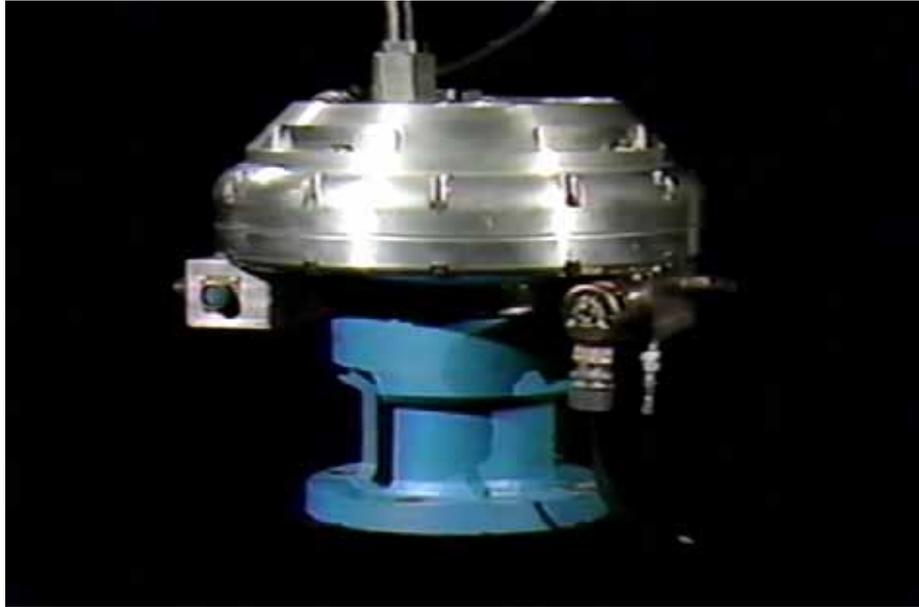
(3) 其他資訊：請參閱附錄 D。

## 6. Tyco International, Inc. 核能相關產品介紹：

Tyco International, Inc. 的子公司 Tyco Flow Control，其所屬的 Anderson Greenwood Crosby (AGC) 專門生產核能相關產品，其產品種類繁多，包括壓力釋放閥、手動閥與歧管、止回閥、球形閥、相關輔助設備與核能級服務等，更詳細的介紹請參閱附錄 E。

## 7. 設定壓力驗證裝置 (SPVD) 之原理與功能：

(1) 設定壓力驗證裝置 (Set Pressure Verification Device, SPVD) 為 Crosby 公司所研發之產品，用於安全釋放閥之設定壓力測試，其構造如下圖：



- (2) SPVD 於測試時將拉伸組件(SPVD/LW HEAD)安裝於 MSSRV 上方，使拉伸機構與 MSSRV 之閥桿連接，測試時只需將 SRV 進口壓力提昇至該只 MSSRV 銘牌設定壓力之 75%左右(約 900 psig)。
- (2) 而剩下到跳脫點之差壓大約 25%，則由外部輸入之壓縮空氣推動拉伸組件內之囊狀氣缸提供，此空氣推動力量會由負載感測元件 (Load Cell) 感測並將信號送至電腦控制器。
- (3) 當此推動力量大到足以使 MSSRV 產生跳脫動作時，則此跳脫升程會由 LVDT 設備感測並將信號送至電腦控制器，電腦會記錄此時之 MSSRV 進口蒸汽壓力 ( $P_{in}$ ) 及由負載感測元件所得

到之力量 (F)，並同時通知控制儀用空氣輸入的電磁閥關閉，當儀用空氣停止輸入後，MSSRV 之閥桿會因急洩開啟 (Popping) 動作而繼續微量開啟。

(4) 此MSSRV之跳脫值P (還不是設定壓力) 係由下列公式求得：

$$P = P_{in} (\text{MSSRV進口蒸汽壓力}) + F (\text{SPVD之拉力}) / A$$

其中A為SRV之閥座面積值。

P值尚需經「環境溫度校正數據」修正後始為最終之設定壓力值。

## 8. MSSRV 之設定壓力及洩漏測試技術

以下步驟中所標示之零件號碼請參閱前述之附圖 01。

### (1) 設定壓力測試

- 1.1 MSSRV 壓力設定點之調整，是依照銘牌標示之設定壓力值，將壓力設定點調整到銘牌標示之設定壓力值之 $\pm 1\%$ 範圍內，以蒸汽為媒介，加溫模擬上乾井環境溫度（ $54.44^{\circ}\text{C} \sim 65.55^{\circ}\text{C}$ ）並保持熱穩定，連續循環的成功操作 4 次後，記錄閥開啟時之壓力。
- 1.2 閥在每次急開(Popping)動作時皆處於熱穩定(Thermal Stabilization)狀態，所謂熱穩定狀態就是 MSSRV 之閥體和閥罩外殼在 30 分鐘內其溫度變化低於 $\pm 2^{\circ}\text{C}$ ，其量測位置參考附圖 03。
- 1.3 溫度校正：
  - 1.3.1 測試設定壓力跳脫時如果環境溫度小於或大於  $57.22^{\circ}\text{C}$  時，所要求的壓力設定值就必需經過校正。
  - 1.3.2 溫度校正方法如下述的公式：  
設定壓力 = 實際跳脫值  $\pm$  校正值(如溫度超過  $57.22^{\circ}\text{C}$  則加校正值，低於  $57.22^{\circ}\text{C}$  則減校正值)。
- 1.4 如必要應重覆調整及連續循環的測試，直到操作測試在一致的公差範圍內。
- 1.5 壓力設定點之調整步驟如下：
  - 1.5.1 將 MSSRV 裝於測試台。
  - 1.5.2 緩慢的增加蒸汽壓力至設定壓力（設定壓力即閥剛開啟而流體持續外流時之壓力）。
  - 1.5.3 如果設定點非在需求範圍內，則須調整主彈簧壓力。
  - 1.5.4 利用鬆開 4 只內六角螺絲（81）來調降下彈簧之彈力和壓力設定點：以順時針之順序非常少量而漸漸增放鬆內六角螺絲，調整時應保持閥蓋板（40）與閥罩（20）頂面平行。
  - 1.5.5 調升壓力設定點：拆除 4 個分裂調整套（44），均勻的以非常少量而漸增鎖緊 4 只內六角螺絲（81），調整時應時常檢查閥蓋板（40）與閥罩（20）頂面是否平行，閥蓋板（40）與閥罩（20）頂面之距離大約每變化 0.001” 將導致設定壓力改變大約 0.5 psig，閥蓋板（40）與閥罩（20）頂面之距離若減少，則設定壓力增大，閥蓋板（40）與閥罩（20）頂面之距離若增加，則設定壓力減少。
  - 1.5.6 正確的壓力設定點的建立，必須經過 4 次的重覆的測試且其測試

值皆在銘牌標示之設定壓力值 $\pm 1\%$ 以內。

1.5.7 壓力設定點確認後，量測閥蓋板（40）與閥罩（20）頂面之距離（參考附圖），加工 4 個分裂調整套（44）來配合量測距離，回裝分裂調整套（44）後確實的以安全鐵絲（68）固定，並將 4 只內六角螺絲（81）確實鎖緊扭矩。

1.5.8 再次測試壓力設定點。

1.6 接受標準：

1.6.1 閥之設定點在需求限制範圍內。

1.6.2 閥之操作順暢，無卡住或受約束等現象。

(2) 閥座洩漏（密閉）測試：

1.1 在設定壓力調整完成並已符合調整時相關需求時，MSSRV 將用蒸汽作為工作流體來進行閥座洩漏測試，先將內部蒸汽之壓力提升並維持至初始壓力 6.89 Mpag，再加溫模擬上乾井環境溫度（54.44 $^{\circ}$ C～65.55 $^{\circ}$ C），且控制成熱平衡（Thermal Equilibrium）狀態。

1.2 熱平衡之定義就是 MSSRV 之閥體和閥罩外殼在 30 分鐘內其溫度變化低於 $\pm 2^{\circ}$ C。

1.3 將蒸汽壓力緩慢的升至設定壓力之 90%。

1.4 用一個冷鏡（Cold Mirror）或精密光面穿入 MSSRV 內，環繞觀察閥座區之噴嘴面，以一正確合適之角度來反射出觀察面，觀察時不可使閥之任何部位與冷鏡面接觸。

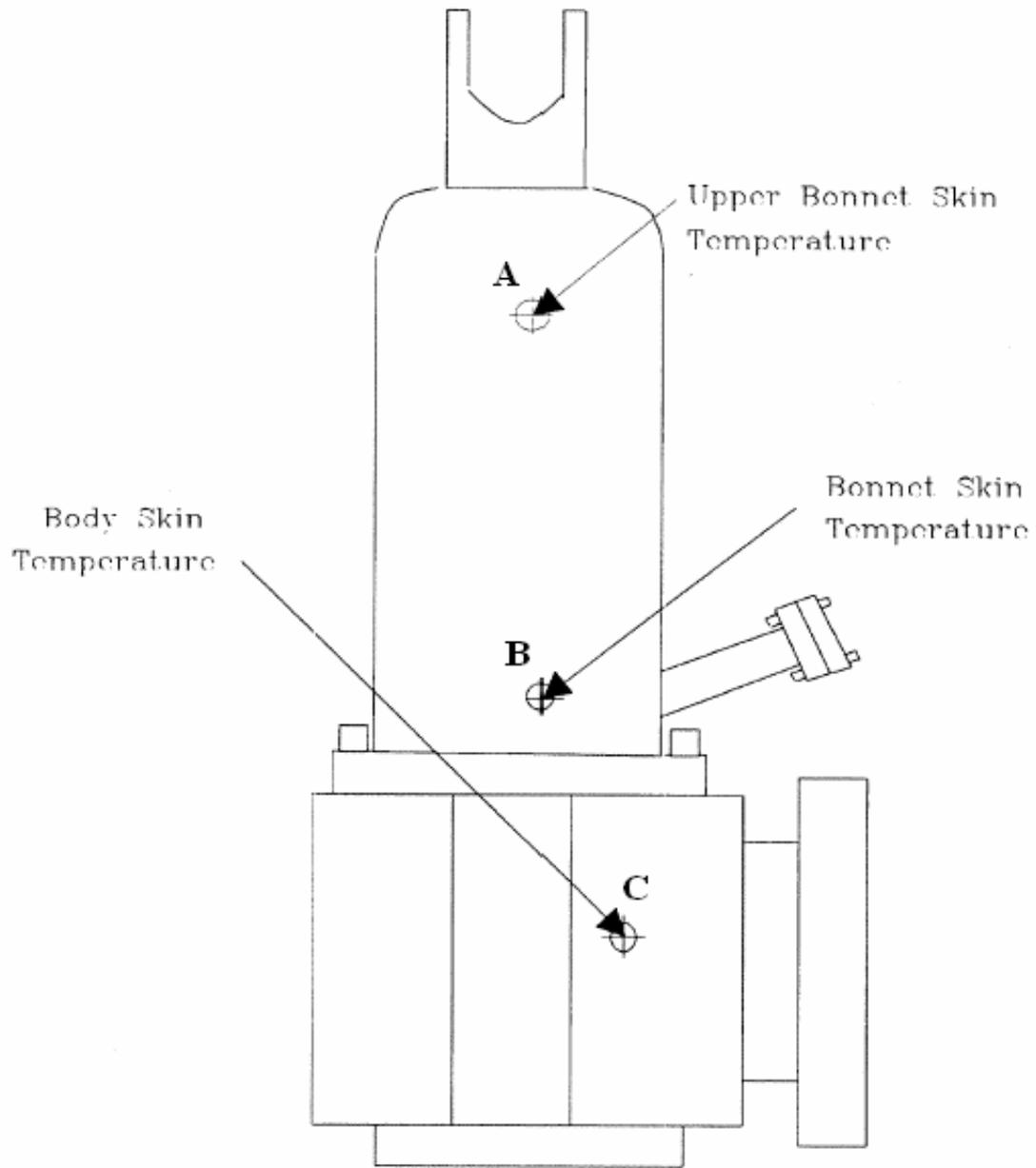
1.5 洩漏檢查應作 3 次，每次至少超過 3 分鐘。

1.6 接受標準：

1.6.1 觀查冷棒鏡（Cold Bar Mirror）有輕微霧氣，是可接受之標準，霧氣之定義就是由小水滴形成，而小水滴不能大到當鏡面拿垂直時足以沿垂直鏡子滾落或滴落，若小水滴凝結成大水滴由鏡面掉落，是不可接受的。

1.6.2 另一替代方法，就是在 15 分中內零洩漏，使用冷凝方法測試或容積測試量測。

附圖 03 MSSRV 閥體及閥罩外殼熱穩定溫度量測點位置圖



**TEMPERATURE LOCATIONS**

### 三、心得

- (一) 由於本公司三座核能電廠的安全釋壓閥都沒有使用過 Target Rock 公司產品的經驗，對 Target Rock 公司之業務與產品也不甚熟悉，不免對核四廠的 MSSRV 品質有所疑慮，透過本次出國研習的機會，可以近距離與該公司工廠部門的結構、系統與品管人員接觸，並參觀 MSSRV 的測試設備。由於該公司持有多項 ASME 資格認證 (N、NV、NPT)，其各項產品的製程皆有嚴格管控，且工程人員的技術水準也值得信賴。
- (二) 透過本次的研習，充分了解本廠的 MSSRV 較友廠的 MSSRV 有許多改良之處，增加設備之可靠度：
1. 以杯形彈簧墊圈 (Bellville Spring Stack) 取代傳統的螺旋形彈簧 (Helical Coil)，可消除彈簧之側向負載，提供一致且穩定的設定壓力動作點。
  2. 硬化處理的螺紋式進口噴嘴 (**Threaded Nozzle**) 座面，可抵擋流體的侵蝕。
  3. 閥盤採用 Target Rock 工廠研發的 FLEX-C DISK 設計，使閥盤在閥座面可彈性配合閥座因熱效應產生的微小變化，密封效果更佳。
  4. 由於 MSSRV 的活塞 (Piston) 與套筒 (Liner) 間有環形間隙，當閥盤開啟瞬間，部分蒸汽將藉此間隙流進活塞上方空間。Target Rock 在 MSSRV 閥帽下部的 2" 微排氣管內設計了一個限流板 (Orifice)，用來控制活塞上方空間的壓力，協助閥盤坐緊閥座，並可消除閥盤回座時的浮動現象。
- (三) 本次研習期間，與 Target Rock 公司的結構與系統工程師共同研討 MSSRV 的分解、組裝及檢修技術，獲益良多，對未來的維護與保養有更深刻的了解。
- (四) 目前本公司三座核能電廠的安全釋壓閥都是使用 Crosby 公司的產品，透過本次研習，也更了解 Crosby 公司對安全釋壓閥設計與製

造的悠久歷史（1920 年至今）與技術能力。

（五）安全釋壓閥設定壓力驗證裝置（SPVD）為 Crosby 公司的專利產品之一，核一廠曾有使用經驗，可節省測試蒸汽使用量與測試時間，透過本次研習機會，Crosby 公司也利用影片輔助教學，介紹 SPVD 的構造、原理與功能，獲益良多。

（六）目前核一廠及核二廠的測試設備都是由 Crosby 公司設計整合與製造安裝，而 Crosby 工廠也擁有完整的測試設備與迴路，本次研習，透過研討與經驗交流，對 MSSRV 之設定壓力及洩漏測試技術有更深刻的認識，對未來核四廠測試廠房之建置也有完整的概念。

## 四、建議事項

- (一) 本次出國實習前，已先進行資料收集，包括友廠安全釋壓閥相關程序書與圖面，測試設備與檢修機具之照片及測試法規相關資料，並在出國前先行研讀，做初步了解，故在赴廠家實習期間，能明確訂出研習主題，在有限的時間內學習更多技術。建議出國人員在出國前應做充分準備，方能有效達成任務與目標。
- (二) 由於友廠現有的安全釋壓閥測試設備已漸趨老舊，建議核四廠仍應自行建置一套測試設備，提供電廠大修期間離線測試 MSSRV 之能力，既可符合法規要求，又可縮短大修工期。而建置本套測試設備之時機，以商轉後開始建造到一號機第一次大修（1EOC-01）前完成為宜。
- (三) 依法規（ASME OM Code）要求，所有同型同廠牌的安全閥，每 5 年（一個測試區間）須測試 100%，且每 2 年至少須測試 20% 之前未測試過的閥。因電廠每次大修之週期為 18 個月，故建議核四廠未來對於安全釋壓閥的維護策略宜以 4.5 年（即 3 次大修）為一個測試區間，前三次大修（第 18、36 與 54 個月）至少各測試 33%（6 只 MSSRVs），如此第一個 4.5 年共可測試 100%（18 只 MSSRVs），符合法規要求。
- (四) 核四廠目前處於建廠階段，MSSRV 預定在試運轉階段結束，Fuel Loading 以前進行安裝，之後配合機組起動進行相關測試。雖然起動測試項目並無需執行設定壓力測試，惟仍建議核四廠應先採購最少需求量之 MSSRV 備品（建議最少需 6 只），並利用友廠現有的離線測試設備，建立足以測試核四廠 MSSRV 設定點壓力之能力，以備不時之需。

## 附錄

- A. Target Rock 公司介紹
- B. Target Rock 產品介紹
- C. Target Rock 工廠測試設備參觀照片
- D. Tyco International Inc. 公司介紹
- E. Tyco International Inc. 產品介紹

附錄A. Target Rock公司介紹

# STATEMENT OF CAPABILITIES AND QUALIFICATIONS



**The Most Diverse Line Of Nuclear  
Safety-Related Flow Control Components**



## Target Rock

Division of Curtiss-Wright Flow Control Corporation

Target Rock, Division of Curtiss-Wright Flow Control Corporation  
1966E Broadhollow Road, East Farmingdale, New York 11735  
Phone: (631) 293-3800 FAX: (631) 293-6144

## TABLE OF CONTENTS

1.0	COMPANY INFORMATION.....	3
1.1	Basic Information.....	3
1.2	Summary of Company History .....	3
2.0	MAJOR PRODUCTS .....	4
2.1	Product Lines .....	4
2.2	Available Equipment Qualifications.....	5
3.0	FACILITIES .....	5
3.1	Main Manufacturing Facility .....	5
3.2	Branch Facilities .....	5
3.3	Sub-Contractors .....	5
4.0	PERSONNEL .....	6
4.1	Number of Employees .....	6
4.2	Status of Technical Certificate Holders .....	6
4.3	Certified NDE Personnel .....	6
5.0	EXPERIENCE .....	7
5.1	Recent Scopes for Supply for Major Projects.....	7
5.2	Overview of Installed Base.....	7
6.0	QUALITY SYSTEMS.....	8
6.1	Status of Quality Assurance System.....	8
6.2	List of the Certificates of Authorization .....	8
6.3	List of Codes and Standards Regarding Design, Manufacture, and/Or Tests .....	9
6.4	Tests and Inspection Procedures .....	9
7.0	DESIGN/CALCULATION/TOOLS .....	10
7.1	Design Analysis .....	10
7.2	Software .....	10
8.0	FINANCIAL STATUS.....	10

### Attachments

1. Equipment List
2. Overview of Target Rock Nuclear Safety-Related Installed Base
3. ASME Certificates

## 1.0 COMPANY INFORMATION

### 1.1 Basic Information

**Company Name** Target Rock, Division of Curtiss-Wright Flow Control Corporation

**Address** 1966E Broadhollow Road  
E. Farmingdale, New York 11735  
U.S.A.

**Phone:** 1-631-293-3800

**Fax:** 1-631-293-4949

**Points of Contact** Mr. Steven Pauly, Director - Commercial Business \*Main Contact  
Mr. James White, General Manager  
Mr. Heath Lew, Asian Business Manager (President, CWFC-Korea)  
Mr. Robert Glazier, Commercial QA Manager

**Parent Company** Curtiss-Wright Corporation  
4 Becker Farm Road  
Roseland, New Jersey 07068  
U.S.A  
[www.curtisswright.com](http://www.curtisswright.com)  
New York Stock Exchange Symbol: CW

### 1.2 Summary of Company History

- Date Business Founded: 1951
- Original Company Name: Target Rock Corporation
- Date of Commencement of Supplying The Item for Application: 1953
- Changed company name to Curtiss-Wright Flow Control Corporation in 1997.
- Acquired Enertech USA in 1998 (now known as Enertech Division of Curtiss-Wright Flow Control Corporation)
- Acquired Farris Engineering in 1999 (now known as Farris Engineering Division of Curtiss-Wright Flow Control Corp)
- Acquired Solent & Pratt in 2001 (now known as Solent & Pratt Division of Curtiss-Wright Flow Control Corporation)
- Acquired Electro-Mechanical Division (EMD) from Westinghouse in 2002

## 2.0 MAJOR PRODUCTS

### 2.1 Product Lines

Target Rock designs, manufactures, assembles, and tests the following types of nuclear safety-related valves:

Description	Line Size Range	Design Pressure (Max)	Design Temperature (Max)
Solenoid-Operated Isolation Valves, including: <ul style="list-style-type: none"> <li>▪ Reactor High Point Vent Valves</li> <li>▪ Sampling Valves</li> <li>▪ Power-Operated Relief Valves</li> <li>▪ Containment Isolation Valves</li> </ul>	3/8 in. to 6 in.	2500 psig	700°F
Solenoid-Operated Control Valves, including: <ul style="list-style-type: none"> <li>▪ Emergency Feedwater Control Valve</li> <li>▪ Pressurizer Spray Valve</li> <li>▪ Steam Dump Valve</li> </ul>	1 in. to 6 in.	2500 psig	700°F
Pilot-Operated Pressurizer Safety Valves	6 in. x 6 in.	2500 psig	700°F
Pilot-Operated Main Steam Safety/Relief Valves	6 in. x 10 in.	1250 psig	575°F
Direct-Acting Main Steam Safety Valves	6 in. x 10 in.	1385 psig	585°F
Direct-Acting Main Steam Safety/Relief Valves	8 in. x 10 in.	1385 psig	585°F
Direct-Acting Safety and Relief Valves	3/4" x 1" thru 2" x 3"	2500 psig	700°F
Motor Operated Valves for Severe Service	2 in. to 6 in.	2500 psig	700°F
Pressure Regulators	1 in.	3000 psig	400°F
I/P Converters	N/A	N/A	N/A
AOV 3-Way Pilot Solenoid Valves	N/A	N/A	N/A
Valve Skids	N/A	N/A	N/A

## 2.2 Available Equipment Qualifications

Target Rock valves have been tested and qualified to a wide variety of demanding conditions required by industry standards, including:

1. ANSI B16.41
2. ASME QME-1
3. IEEE 323
4. IEEE 344
5. IEEE 383
6. Others upon request

In addition to these, Target Rock's solenoid valve technology has been subjected to a rigorous design review and in-situ test program resulting in approval of our designs for use in Russian NPP designs.

## 3.0 FACILITIES

### 3.1 Main Manufacturing Facility

Total Areas: 740,000 ft.<sup>2</sup>  
Indoors: 240,000 ft.<sup>2</sup>  
Outdoors: 500,000 ft.<sup>2</sup>  
Total Floor Space: 240,000 ft.<sup>2</sup>  
Classification of Ownership: Own

Please refer to the Attachment 1 equipment List for a summary of the equipment in use at this facility.

### 3.2 Branch Facilities

- A. SPLAV  
Velikiy Novgorod, Nekhinskaya, 61  
Russia 173021
- B. CWFC-Korea  
3Ma 713 Siwha National Industrial Complex  
Jungwang-Dong Sihung-Si  
Kyunggi-Do Korea 429-450

### 3.3 Sub-Contractors

Forgings and Castings are outsourced. All other work is performed in house.

#### 4.0 PERSONNEL

##### 4.1 Number of Employees

Engineering Design	Manufacturing Production	Test Inspection	Quality Management	Total
34	94	20	12	211

##### 4.2 Status of Technical Certificate Holders

Name	Current Position	Description of Qualification (Grade)	Acquired Date	Issuing Organization
Richard Langseder	Vice President	Professional Engineer	2/74	New York
Adele DiBiasio	Project Engineer	Professional Engineer	2/89	New York
Vito Liantonio	Manager	Professional Engineer	2/74	California
Nick Campanelli	Project Engineer	Professional Engineer	2/94	New York
Daniel Wynn	Director	Professional Engineer	8/85	New York

##### 4.3 Certified NDE Personnel

Test Method	Level 1	Level 2	Level 3
Ultra-Sonic	0	0	1
Radiographic	0	0	1
Magnetic Particle	0	0	1
Liquid Penetrant	0	2	1
Visual	0	3	1
He-Leakage	0	2	1

## 5.0 EXPERIENCE

### 5.1 Recent Scopes for Supply for Major Projects

Customer	Item Description	Plant	Number of Valves	Supplied Date
Rosenergom	Solenoid Valves	Leningrad	6 Valves	2002, 2004
General Electric	Main Steam Safety /Relief Valves	Lungmen 1/2	36 Valves	2004
Doosan	NSSS SOV	Ulchin 3 & 4	28 Valves	1995
Doosan	NSSS SOV	Ulchin 5 & 6	28 Valves	2000 thru 2003
Doosan	NSSS SRV	Ulchin 3 & 4	90 Valves	1995
KHNP	BOP SOV	Ulchin 3 & 4	216 Valves	1996
Doosan	NSSS MOV	Ulchin 3 & 4	8 Valves	1996
Doosan	NSSS MOV	Yonggwang 3 & 4	8 Valves	1994
Doosan	NSSS MOV	Yonggwang 5 & 6	8 Valves	1999
Doosan	NSSS MOV	Ulchin 5 & 6	8 Valves	2002
KHNP	BOP SOV	Yonggwang 5 & 6	>150 Valves	1999
KHNP	BOP SOV	Ulchin 5 & 6	>150 Valves	2001 thru 2002
KHNP	BOP SRV	Yonggwang 5 & 6	>300 Valves	1999 thru 2001
KHNP	BOP SRV	Ulchin 5 & 6	>300 Valves	2001 thru 2002

### 5.2 Overview of Installed Base

Target Rock has over 3,000 valves installed in nuclear safety-related applications worldwide.

Attachment 2 provides an overview of this installed base by plant.

## 6.0 QUALITY SYSTEMS

### 6.1 Status of Quality Assurance System

Has QA System been established	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Date of Establishment	1953
Applied Code *& Standard for QA System	NQA-1		
Have external audits for QA System been Performed? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Auditing Organizations	Last Audited Date	Remarks
	ASME and NUPIC	December, 2004	Periodic

An uncontrolled copy of the Target Rock QA Manual is available upon request.

### 6.2 List of the Certificates of Authorization

Description	Authorizing Organization	Effective Period	Certified Items	Address of Certified Shop
"N" Stamp	ASME	12/12/07	Solenoid Operated Valves	CWFC, Target Rock Division
"NV" Stamp	ASME	12/12/07	Safety Relief Valves	CWFC, Target Rock Division
"NPT" Stamp	ASME	12/12/07	SOV & SRV Components	CWFC, Target Rock Division

A copy of our ASME certificates is provided as Attachment 3.

### 6.3 List of Codes and Standards Regarding Design, Manufacture, and/Or Tests

No.	Issuer	Code/Standard No.	Subject	Issued Year
1	ASME	Sec. I, II, III, V, VIII, IX, XI, NQA-1, QME-1	Boiler & Pressure Vessel Code	2001 Edition, 2001 Addenda
2	ANSI	B.16.34, B16.5, B16.41, B31.1, B16.10, B16.11		1996, 1996 1983, 2001, 2001, 2002
3	NRC	10CFR50		2002
4	MSS	SP61, SP25	Manufacturer's Standards	1999, 1998
5	IEEE	382, 323,344,384	Electrical	1985, 1983, 1987, 1992
6	API	527		1991
7	NRC	Generic Letters & Reg. Guides		Latest
8	ASTM	Various		Latest

### 6.4 Tests and Inspection Procedures

No.	Title	Documentation No.	Organization Covered
1	Non-Destructive Examination - LPI	1689 2297	Inspection
2	Steam, Water, Gas Testing	6732 6614	Assembly and Test
3	Weld Qualification & Verification	11.210 11.800 12.100	Metallurgical Laboratory

## 7.0 DESIGN/CALCULATION/TOOLS

### 7.1 Design Analysis

Target Rock routinely performs necessary analysis and evaluations to prepare Design Report in accordance with ASME Code requirements. An example of a typical Design Report can be provided upon request.

### 7.2 Software

Program Name	Developer	Application
IDEAS Master Service	SDRC	CAD

## 8.0 FINANCIAL STATUS

Financial Data is reported by our parent company, Curtiss-Wright Corporation. The latest Annual Report is available from our website at [www.curtisswright.com](http://www.curtisswright.com).

## ATTACHMENT 1

### Equipment List - Target Rock, E. Farmingdale, NY

- Automatic Lapping Equipment
- Logan 15" Toolroom Lathe
- Veeco-Leak Detector
- B & S Tool & Cutter Grinder
- Hardinge Toolroom Lathe
- Marvel Hacksaw
- Martin Gap Bed Lathe 27"
- Dar 300 Hfgw Welding Machine
- Spiratron Finishing Machine
- Prec. Harding Chuck Lathe
- Bridgeport Mill (Modified)
- Royal 16" Poy Index Chuck
- Royal 9 1/2 Self Center Comp Chuck
- Wpc 25 Unique Weld Positioner
- Cincinnati-Heavy Duty Wet Grinder
- Special Burring Machine
- Hitachi Seiki #5a Turret Lathe
- Hitachi Seiki #5a Turret Lathe
- 2 Floating Holder, 5 Drawer Holder
- 4 Revolv Ctr & Tool & Draw Holder
- 10 Adj. Cutter Holder (Long)
- Royal 16" Roto Jaw Chuck
- 15" Cushman 4 Jaw Chuck Wa8sp
- 3 Jaw Univ Chusman Chuck
- Royal 18" Roto Jaw Chuck
- Peenamatic Blasting Machine
- Tooling-3" Straight Body
- Tooling #820-21779368
- 2 Cutter Rel Heads
- 2 Digital Readout Tedd Mod 1510b-Cf
- 2 Digital Readout Tedd Mod 1510b-Cf
- Royal 18" Roto Jaw Chuck
- Royal 24" Roto Jaw Chuck
- Hitachi #7d Auto Turret Lathe
- Schaudt Cylindrical Grinding Machine
- Royal 18" Roto Jaw Chuck
- Royal 24" Roto Jaw Chuck
- Hardinge Lathe
- Boring Bars, Cutting Blocks
- Branson Caliper 100
- Ipsen Box Furnace
- Baldwin Southwark Tensile Tester
- W & S Turret Lathe #5
- Hitachi Seiki 4 Mkp Horiz. Mill
- Royal 24" Roto Jaw Chuck
- Grinder Gage System
- Blohm Hfs 9 Surface Grinder
- Moore Jig Grinder
- Gundrill Sharp Fixture & Insert
- Hardinge Speed Lathe W/Accessories
- Kasto Hacksaw Supp Column
- American Lathe W/Scanomatic Tracer
- American Radial Drill
- Krautta & Weber Spec. Drill
- J & L Turret Lathe #10a
- Morando Accessories
- Continental Abrasive Saw
- Morando Vbm 47"
- 6" Carbide Tool Grinder
- B & S Universal Tool Grinder
- American Heavy Duty Tracer Lathe
- Overhead Crane
- Okamoto Model Prg-6 Rotary Surface Grinder
- Atts To Kuraki Horiz Boring/Milling Machine (3)
- Bridgeport Vertical Milling Machine
- Grinder Psg-125 & Att Okamoto Column Type
- Toshiba Mdl Tmc-20a Vert Boring & Turning Mill
- Leblond Regal Lathe
- Hitachi Seiki Model 7d
- Ransome Aprr Power Turning Roll
- Kuraki Horiz Boring & Millg Mach Mdl Kbt-1003w
- Mazak Slant Turn 60 Cnc Lathe W/Fanuc Control
- Drill Jig

- Hitachi Seiki Model 7d
- Atts To Okomoto Surface Grinder Psg-125
- Hitachi Seiki Model 7d
- Ransome Aprr Power Turning Roll
- Weldon Apg-1632 Cnc Profile Grinder
- Filmatic Centerless Grinder
- Mazak Super Quick Turn 18ms Cnc Lathe
- Tooling For Horizontal Machine Center
- Equipment For Horizontal Machine Center
- Tooling For Mazak H-800 & Adapters
- Mazak Hort H-800 Mach Center
- Hardinge Lathe Cnc Retrofit
- Boring Heads For Mazak H-800
- Mazak Vert. Mach Center
- Indexing Head & Base Plate For Mazak V-414
- Model 412 Starter Package For Mazak V-414
- Collets
- Mitsubishi Edm Machine (M25j)
- Mazak Slant Turn Cnc Milling Cntr
- Overhead Crane For Chucker
- Wheelhead Assembly For Grinder
- Milling Machine
- Toshiba #75n-20a Boring Mill
- Mp5 3621 Read Out & Cross Feed
- Hardinge Lathe
- American Engine Lathe
- Hardinge Lathe
- #13 Brown & Sharp Universal Grinder
- Le Blond Lathe & Attachment
- Hydro Feed For 3ne Hitachi Lathe
- Hardinge Chucking Machine
- Contour Sawing Band Machi8nr
- Okamoto Surface Grinder #928
- Landis Grinder & Accessories
- Tape Punch & Memory Option-Toshiba
- Mazak Slant Turn 15
- Hobart Ac/Dc Mach Hct-300
- Sunnen Honing Machine
- Harrington Wilson Daum Drill Grinder
- Plotter For General Numeric
- Internal Threading Unit
- Ecoa Mars Cars
- Precision Tool Room Lathe
- Surface Grinder And Accessories
- Chucking Machine
- Shizuoka Mod. Vertical Turret
- Okuma Turning Center
- Okamoto Surface Grindr
- Nomura Boring & Milling Mach
- Yci Vertical Milling Mach
- Okamoto Mach Model 820n
- Tool Holder For Tmc-20a
- Charmilles/Andrew Edm
- Tool Holder For Tmc-20a
- Mazak Vertical Milling Machine
- Wf Wells Band Saw
- Hardinge Toolroom Lathe
- Mazak Slant Turn
- Autosonic Degreaser
- High Speed Gap Bed Lathe
- Ram Type Turret Lathe
- Automatic Downfeed Mechanism
- Used Hitachi Turret Lathe
- Used Tos Engine Lathe
- Used Bridgeport Milling Mach
- Power Tilt & Hydraulic Hold Dwn
- Gap Bed Engine Lathe W/Access
- 10" 3-Jaw Chuck & Drill Socket Mt#4
- Rebuild 1974 Turret Lathe 10a
- Vertical Milling Machine W/Acc
- Bridgeport Milling Mach
- Hardinge Tool Room Lathe
- Dehoff Dual Spindle
- Rebuild 1971 Turret Lathe 7d
- Rebuild 1976 Morando Vbm 47"
- Uni-Tek Metal Disintegrator
- Okuma Cnc Turning Center
- Atmosphere Recirculating Furn
- Emission Quantometer Syst
- Rebuild 1971 Hitachi Seiki #7d
- Turrent Lathe Guard Assembly
- Lathe Guard

- Detergent Degreasing System - East Building
- Detergent Degreasing System - West Building
- Rebuild 1971 Hitachi Seiki Turret Lathe
- Rebuild 1971 Hitachi Seiki Turret Lathe
- Mazak Programming System Cam-32a
- Gtiii Plus Station
- Jad Specialty B&S Micro Hite
- Gomiya Inc.-Nomura Facing Center
- Technara Facing Center Tooling System
- Roto Technology Inc Cnc Id Grinder
- Machinery Values Burgemaster
- Tooling For Nomura Equipment
- Nomura Facing Center With 90 Tool Atc
- Tooling For Nomura Equipment
- Cnc Id Grinder
- To Upgrade One Seat Mastercam
- Cnc Grinder To Reduce Lapping
- Tooling For Nomura Equipment
- Cnc Grinder To Reduce Lapping
- Hot Loop Construction
- Hot Loop Construction
- Used Pexto Mechanical Squaring Shear
- Maruka
- Bridgeport Vertical Milling Machine
- Cutter Grinding Equip. To Increase Mfg Output
- 30-Ton Filtrine Oil Chiller - Trans. From Sprague
- Temperature Recording Instruments
- Master Cam Cnc Programming System
- Mastercam Mill Version 5.5/Lathe Version 5.5

## Attachment 2 - OVERVIEW OF TARGET ROCK INSTALLED NUCLEAR SAFETY-RELATED BASE

Plant	Customer	Solenoid-Operated Valves					Safety and Relief Valves					PReps	MOVs
		SOV-Isolation	SOV-Control	FW Control	Pzr Spray	PORVs	SRVs	Pzr Safety	MSSVs	MSRVs			
Angra	Furnas Centrais Electric	0											
Almaraz Nuclear Power Plt. 1 & 2	Compania Sevillan de Electricidad	0											
Arkansas Nuclear 1 & 2	Entergy	0	0	0									0
Asco Nuclear Units 1 & 2	Fuerzas Electricas de Cataluna, SA	0								0			
Beznau Nuc. Pwr. Plt.	NOK (Switzerland)	0											
Beaver Valley No. 1 & 2	Duquesne Light Company	0						0					
Big Rock Point Plant	Consumers Power Company	0				0				0			
BKS-KKM Nuclear Power Station	Bernische Kraftwerke AG	0											
Braidwood Stations Units 1 & 2	Commonwealth Edison	0						0				0	
Brown's Ferry Units 1 & 2	Tennessee Valley Authority	0								0		0	
Brunswick Steam Electric Plant	Carolina Power & Light Company	0								0		0	
Bryon Station Units 1 & 2	Commonwealth Edison Company	0						0		0		0	
Callaway Nuclear Station 1 & 2	Union Electric Company	0											
Calvert Cliffs	Baltimore Gas & Electric Co.	0											
Centrale Nucleare Alto Lazio	AMN	0											
Chin Shan Nuc. Pwr. Plt.	Taiwan Power Co.	0											
Clinton Power Station - Unit 1	Illinois Power Company											0	
Comanche Peak Units 1 & 2	Texas Utilities Generating Company	0											
Cooper Nuclear Station	Nebraska Public Power District	0								0			
Crystal River Unit #3	Florida Power Corporation	0	0	0									
D.C. Cook Nuclear Power Plant	Indiana/Michigan Elec. Co.	0											
Davis-Besse Nuclear Power Plt.	Toldeo Edison	0		0									
Diablo Canyon Units 1 & 2	Pacific Gas & Electric Company	0											
Dresden Stations 2 & 3	Commonwealth Edison Company	0								0		0	
Duane Arnold Energy Station	Iowa Electric Light & Power Co.	0								0			
E.I. Hatch	Georgia Power	0								0			
Enrico Fermi #2	Detroit Edison	0								0			
Joseph M. Farley Nuclear Plant Units 1 & 2	Alabama Power Company	0											
J. A. Fitzpatrick Nuclear Plant	New York Power Authority	0								0			
Fort Calhoun - No. 1	Omaha Public Power District	0											
Grand Gulf Nuc. Station	Entergy	0											
Hope Creek Nuclear Generating Station Unit 1	Public Service Electric & Gas Co.	0						0		0			
Indian Point - No. 3	New York Power Authority	0											

131001 0007

## Attachment 2 - OVERVIEW OF TARGET ROCK INSTALLED NUCLEAR SAFETY-RELATED BASE

Plant	Customer	Solenoid-Operated Valves					Safety and Relief Valves				PREgs	MOVs
		SOV-Isolation	SOV-Control	FW Control	Pzr Spray	PORVs	SRVs	Pzr Safety	MSSVs	MSRVs		
Jose Cabrera Nuc. Pwr. Plt.	Union Electrica, SA											
Kewaunee Nuclear Station	Wisconsin Public Service Corp.	0										
KORI - Units 3 & 4	Korea Electric Power Corp.	0	0		0		0				0	
Krsko Nuclear Plant - Yugoslavia	Westinghouse Electric Corporation	0										
Kuosheng Nuclear Power Station Units 1 & 2	Taiwan Power Company	0										
Laguna Verde - Units 1 & 2	Comision Federal de Electricidad	0										
Leningrad	Rosenergom	0										
Limerick Generating Station	Philadelphia Electric Company	0								0		
Lungmen	Taiwan Power Company						0			0		
Maanshan	Taiwan Power Company	0					0					
McGuire Nuclear Station	Duke Power Corporation	0										
Midland	Consumers Power Company	0			0	0						
Millstone	Northeast Utilities	0	0	0						0	0	
Monticello Station	Northern State Power Company	0								0		
Nine Mile Point - Unit 2	Niagara Mohawk Power Company	0										
North Anna Stations 1 & 2	Virginia Electric & Power Company	0									0	
Oconee - Units 1 & 2	Duke Power Company	0			0							
Oyster Creek Nuclear Station	Jersey Central Power & Light	0										
Palisades Nuclear Plant	Consumers Power Company	0				0						0
Palo Verde Nuc. Gen. Station	Arizona Public Service	0					0				0	
Peach Bottom Atomic Power Station Units 2 & 3	Philadelphia Electric Company	0								0	0	
Perry Nuclear Plant Units 1 & 2	Cleveland Electric Illuminating Co.	0					0				0	
Philippine Nuclear Plant 1	Philippine National Power Company		0									
Pilgrim Station No. 2	Boston Edison Company									0		
Point Beach Units 1 & 2	Wisconsin Electric Power Company	0										
Quad Cities Nuclear Power Station	Commonwealth Edison					0				0	0	
Prairie Island Plants 1 & 2	Northern States Power Company	0										
River Bend Station - Unit No. 1	Gulf States Utilities Company	0									0	
H.B. Robinson Plant - No. 1	Carolina Power & Light Company	0								0		
Salem Nuclear Generating Station Units 1 & 2	Public Service Electric & Gas Co.	0										
San Onofre Nuclear Generating Station Units 1, 2, & 3	Southern California Edison Co.	0	0									0
Sequoyah - Units 1 & 2	Tennessee Valley Authority	0	0			0						

**Attachment 2 - OVERVIEW OF TARGET ROCK INSTALLED NUCLEAR SAFETY-RELATED BASE**

Plant	Customer	Solenoid-Operated Valves					Safety and Relief Valves					
		SOV-Isolation	SOV-Control	FW Control	Pzr Spray	PORVs	SRVs	Pzr Safety	MSSVs	MSRVs	PRegs	MOVs
Shearon Harris Nuclear Plants - Units 1 & 2	Carolina Power & Light Company	0										
Sizewell "B"	Nuclear Electric, Ltd.	0	0									
South Texas Project Units 1 & 2	Houston Lighting & Power Co.	0	0									
St. Lucie Plants 1 & 2	Florida Power & Light Company	0	0									0
Sta. Maria de Garona	Nuclenor									0		
Surry Power Stations	Virginia Electric & Power Company	0										
Susquehanna Steam Electric Station Units 1 & 2	Pennsylvania Power & Light Co.	0					0				0	
Three Mile Island	Metropolitan Edison Company	0										
Turkey Point Units 3 & 4	Florida Power & Light Company	0										
Ulchin Units 3 & 4	Korea Electric Power Corp.	0	0	0			0					0
Ulchin Units 5 & 6	Korea Electric Power Corp.	0	0	0			0		0			0
V.C. Summer Nuclear Station	South Carolina Electric & Gas Co.	0										
Vandellos	Hifrensa - Francesa de Energia		0									
Vermont Yankee Nuclear Power Station	Vermont Yankee Nuc. Pwr. Corp.	0									0	
Vogtle Nuclear Plant Units 1 & 2	Georgia Power Company	0	0									
Washington Nuc. Pwr.	Washington Public Power Supply System	0									0	
Waterford Station Unit 3	Louisiana Power & Light Company	0	0				0				0	0
Watts Bar Nuclear Station	Tennessee Valley Authority	0	0			0			0		0	
Wolf Creek Generating Station	Kansas Gas & Electric Company	0	0									
Yonggwang Units 1 & 2	Korea Electric Power Corp.	0	0		0							
Yonggwang Units 3 & 4	Korea Electric Power Corp.	0	0	0								0
Yonggwang Units 5 & 6	Korea Electric Power Corp.	0	0	0			0		0		0	0
Zion Stations 1 & 2	Commonwealth Edison Company	0										

## Attachment 3 - ASME Certificates

01/04/2006 08 21 FAX 212/619628 ASME CONFORMITY ASSESS 0102/004

The American Society of Mechanical Engineers





### CERTIFICATE OF AUTHORIZATION

The certificate accredits the named company as authorized to use the indicated symbol of the American Society of Mechanical Engineers (ASME) for the scope of activity shown below in accordance with the applicable rules of the ASME Boiler and Pressure Vessel Code. The use of the Code symbol and the authority granted by this Certificate of Authorization are subject to the provisions of the agreement set forth in the application. Any construction stamped with this symbol shall have been built strictly in accordance with the provisions of the ASME Boiler and Pressure Vessel Code.

**COMPANY:**  
 TARGET ROCK  
 DIVISION OF CURTISS-WRIGHT FLOW CONTROL CORP.  
 1999E BROADHOLLOW ROAD  
 E. FARMINGDALE, NEW YORK 11736

**SCOPE:**  
 CONSTRUCTION OF CLASS 1, 2 & 3 VALVES AT THE ABOVE LOCATION ONLY

**AUTHORIZED:** FEBRUARY 18, 2006  
**EXPIRES:** DECEMBER 12, 2007  
**CERTIFICATE NUMBER:** N-1947

*Richard S. Tucker*  
 Chairman of The Boiler  
 And Pressure Vessel Committee

*Alan B. ...*  
 Director, Accreditation and Certification

01/04/2006 08 21 FAX 212/619628 ASME CONFORMITY ASSESS 0102/004

The American Society of Mechanical Engineers





### CERTIFICATE OF AUTHORIZATION

The certificate accredits the named company as authorized to use the indicated symbol of the American Society of Mechanical Engineers (ASME) for the scope of activity shown below in accordance with the applicable rules of the ASME Boiler and Pressure Vessel Code. The use of the Code symbol and the authority granted by this Certificate of Authorization are subject to the provisions of the agreement set forth in the application. Any construction stamped with this symbol shall have been built strictly in accordance with the provisions of the ASME Boiler and Pressure Vessel Code.

**COMPANY:**  
 TARGET ROCK  
 DIVISION OF CURTISS-WRIGHT FLOW CONTROL CORP.  
 1999E BROADHOLLOW ROAD  
 E. FARMINGDALE, NEW YORK 11736

**SCOPE:**  
 CONSTRUCTION OF CLASS 1, 2 & 3 PRESSURE RELIEF VALVES AT THE ABOVE LOCATION ONLY

**AUTHORIZED:** FEBRUARY 18, 2006  
**EXPIRES:** DECEMBER 12, 2007  
**CERTIFICATE NUMBER:** N-1948

*Richard S. Tucker*  
 Chairman of The Boiler  
 And Pressure Vessel Committee

*Alan B. ...*  
 Director, Accreditation and Certification

01/04/2006 08 21 FAX 212/619628 ASME CONFORMITY ASSESS 0102/004

The American Society of Mechanical Engineers





### CERTIFICATE OF AUTHORIZATION

The certificate accredits the named company as authorized to use the indicated symbol of the American Society of Mechanical Engineers (ASME) for the scope of activity shown below in accordance with the applicable rules of the ASME Boiler and Pressure Vessel Code. The use of the Code symbol and the authority granted by this Certificate of Authorization are subject to the provisions of the agreement set forth in the application. Any construction stamped with this symbol shall have been built strictly in accordance with the provisions of the ASME Boiler and Pressure Vessel Code.

**COMPANY:**  
 TARGET ROCK  
 DIVISION OF CURTISS-WRIGHT FLOW CONTROL CORP.  
 1999E BROADHOLLOW ROAD  
 E. FARMINGDALE, NEW YORK 11736

**SCOPE:**  
 CLASS 1, 2 & 3 FABRICATION WITHOUT DESIGN RESPONSIBILITY AND WITH DESIGN RESPONSIBILITY FOR APPURTENANCES ONLY, AND AS A MATERIAL ORGANIZATION MANUFACTURING AND SUPPLYING FERROUS & NONFERROUS MATERIAL INCLUDING UTILIZATION OF UNQUALIFIED SOURCE MATERIAL, QUALIFICATION OF NONACCREDITED MATERIAL ORGANIZATIONS AND APPROVAL AND CONTROL OF SUPPLIERS AT THE ABOVE LOCATION ONLY

**AUTHORIZED:** FEBRUARY 18, 2006  
**EXPIRES:** DECEMBER 12, 2007  
**CERTIFICATE NUMBER:** N-1949

*Richard S. Tucker*  
 Chairman of The Boiler  
 And Pressure Vessel Committee

*Alan B. ...*  
 Director, Accreditation and Certification

## Direct-Acting Isolation Valve

This Solenoid Operated Valve is a direct acting, flow over the seat, solenoid actuated, two-way (on-off), energize to open (fail closed) valve designed for low flow applications. The valve trim and plunger assemblies are designed to provide high seating forces in both flow directions.

### Design Features



- **Direct-Acting** - The direct acting design does not have a pilot, providing for valve operation and sealing over a wide range of pressures as well as simplifying maintenance and eliminating a potential leak path.
- **High Opening Forces** - Magnetic force increased by up to 400% through changes to coil and plunger designs to lift against the higher seating forces of the new disc and spring design.
- **Simplified Maintenance** - Bolted bonnet design and screw adjustable reed switch clamps reduce maintenance time from hours to minutes.
- **High Performance Reed Switches** - Tight pick-up and drop-out tolerances on the reed switches, combined with the accurate adjustment of the screw adjustable switch clamps, provides highly reliable position indication
- **Low Cobalt** - Low cobalt based hardfacing available.



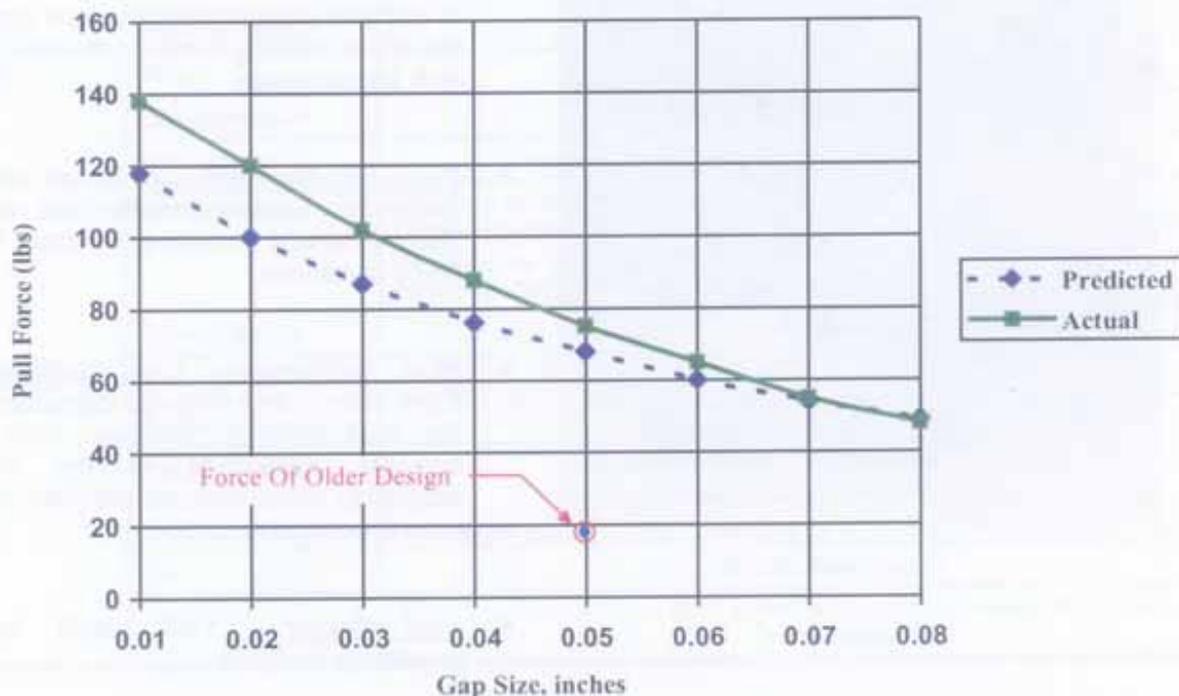
## Enabling Technology

In 1996, a customer requested a new isolation valve design built specifically for their most difficult sampling application, pressurizer steam sampling service. At that time Target Rock was performing development work on magnetic circuit design and it was decided to work with the customer's staff to apply this new technology to this application problem.

The magnetic circuit of a solenoid valve can be affected by a large number of parameters. The main components of the magnetic circuit include the coil, the plunger, and the fixed core; however, all of the components and parts within the influence of the magnetic field have the potential to either conduct or resist the magnetic lines of force. Even the placement of simple hardware items can affect the efficiency of the circuit.

In order to better understand and control these effects, Target Rock developed a detailed computer model of the magnetic circuit for its solenoid valves. This model allows for analysis of subtle changes in component design. By iterative analysis using this sophisticated tool, the forces obtained from a standard "1-inch" coil are optimized. In previous designs, magnetic circuits using this coil have achieved pull forces of approximately 15 lb. over the magnetic gap between the moveable plunger and the fixed core. Since the pull force obtained from the coil dictates the amount of seating force that can be allowed in the valve trim design, increasing the pull force is critical to increasing valve performance.

Computer modeling of the direct-acting valve design has allowed Target Rock to redesign components to achieve a **400% increase** in the coil pull force. By optimizing the dimensions of the metal parts and hardware placement, the same coil is now able to generate over 60 lb of pull force across the same magnetic gap.



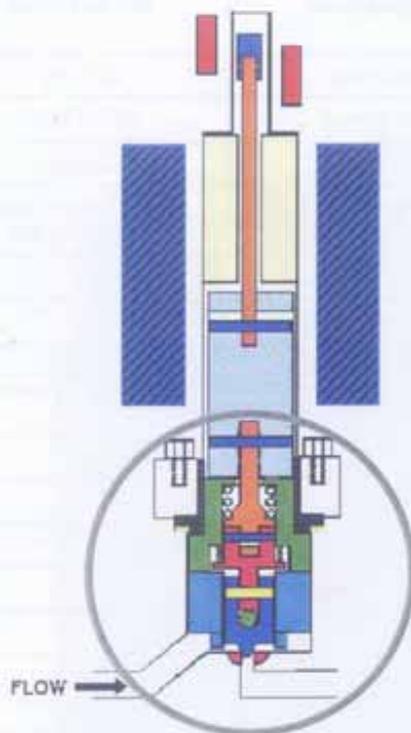
## Operation

The valve is closed when the solenoid coil is de-energized. With the inlet pressurized, the inlet pressure is transmitted to the control chamber above the disc by the clearances around the disc and the sleeve. The lower disc face below the valve seat is exposed to the lower outlet pressure. This pressure differential across the valve seat creates a pressure force acting in the direction of disc seating. The force due to differential pressure is significantly supplemented by the force of the two return springs to provide a strong seating force.

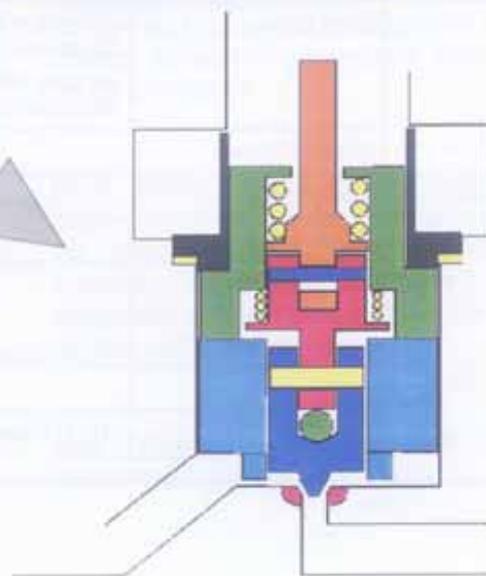
Energizing the solenoid assembly creates a magnetic force. When the force of the upper return spring is overcome by the magnetic force, the plunger pulls the disc rod upward to take up the free space around the disc pin. This action reduces the gap between the fixed core and the plunger, increasing the magnetic force. When the magnetic force increases to greater than the combined force of the upper return spring, lower return spring, and differential pressure, the plunger lifts further. This motion is transmitted through the disc rod to the disc which, in turn, is pulled off its seat in the body, allowing flow through the valve.

The initial motion of the disc rod, to take up the free space around the disc pin, is transmitted through the plunger to the magnet assembly, which opens the lower reed switch(es). When the disc lifts, the additional plunger motion closes the upper reed switch(es) indicating that the valve is in the open position.

When the solenoid assembly is de-energized, the magnetic force is eliminated allowing the return springs to separate the plunger from the fixed core. This motion, transmitted through the disc rod, fully closes the main disc. This valve design does not rely upon the differential pressure to assist valve motion.



- $C_v = 0.16$
  - 2500 psig inlet
  - 0.012 wide seat band
  - 47 lb. of seating force
  - Yields a seat stress of
- 13,250 psi**  
(5.3 x inlet pressure)



 Target Rock

## Valve Data Sheet

Identification	Assembly No.	1033005-2	1033005-4	1033005-5
	Operating Mode	On-Off, Energize To Open (FC)		
	Safety Related?	Yes		
	Code	ASME Section III, Class 1,2, or 3, "N" Stamp		
	Qualification	IEEE 323, IEEE 344, IEEE 382, ANSI B16.41		
Service Conditions	$\Delta P$ Shut Off, Flow Direction	2500 psid (max)	1000 psid (max)	200 psid (max)
	$\Delta P$ Shut Off, Reverse Flow Direction	1000 psid (max)	500 psid (max)	500 psid (max)
	Design Pressure	2500 psig	1000 psig	200 psig
	Operating Temp ( $^{\circ}F$ )	700 $^{\circ}F$ max.	400 $^{\circ}F$ max.	400 $^{\circ}F$ max.
	Rated Flow (max)	$C_v = 0.15$	$C_v = 0.5$	$C_v = 1.0$
	Process Fluid	Steam, Gas, Water, Demin. Water, Borated Water	Water, Demin. Water, Borated Water	Water, Demin. Water, Borated Water
Valve Body	Size/Type	$\leq 1"$ Globe / T-Pattern		
	Material	316 or 316L S.S.		
	Weight	33.5 $\pm$ 3.3 lb.		
	Size Envelope	20 in. high x 6 in. wide x 6 in. deep		
	Bonnet Type	Bolted		
	End Connections	1/4" to 1" Pipe or Tube		
Trim	Ports	Single port		
	Characterization	Quick Opening		
	Trim Material	S.S. with Hardfacing (Low Cobalt)		
	Leak Rate	<2 cc/hr in the flow direction at 2500 psid <4 cc/hr in the reverse flow direction at 1000 psid	<2 cc/hr in the flow direction at 1000 psid <7.5 cc/hr in the reverse flow direction at 500 psid	<2 cc/hr in the flow direction at 200 psid <7.5 cc/hr in the reverse flow direction at 500 psid
	Type of Closure	Spring		
Electrical	Housing Type	NEMA Class 4		
	Conduit Connection	3/4" NPT		
	Electrical Ratings	Coil rated 90 to 140 VDC, 125 VDC nominal, 0.80 amps, Available Option: Rectifier for 120 VAC Available Option: Current Control Unit (CCU) for continuously energized operations		
	Coil	Encapsulated Class H		
	Switches	Up to 2 open and 2 closed SPST controlled dropout reed switches with screw adjustable switch clamps		



# MAIN STEAM SAFETY RELIEF VALVE



## Design Features

*Bellville Spring Stack*

*Threaded Nozzle*

*FLEX-C Disc*

*Fully Qualified  
Air Actuator*

The Target Rock MSSRV design uses steam safety design features that have been proven in use for over 15 years. Target Rock has completed deliveries to Advanced BWR project in Taiwan based on the extensive testing performed for that program. This design is the latest spring-over-disc design available and futures:

**BELLVILLE SPRING STACK** - The Target Rock design employs a Bellville Spring Stack rather than a helical coil. Bellville springs eliminate side loadings to provide consistent and repeatable set pressure actuation.

**FLEX-C DISC** - The Target Rock Main Stem Safety Relief Valve feature our FLEX-C disc design. This disc flexes at the seating surface to exactly match any minute variations in the nozzle seating surface due to thermal effects.

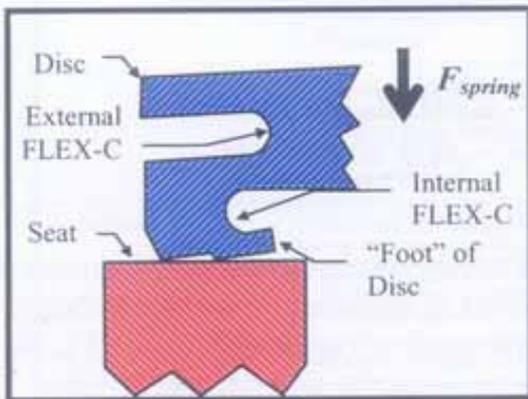


**THREADED NOZZLE** - Hardfaced nozzle seat resists flow damage.

 **Target Rock**

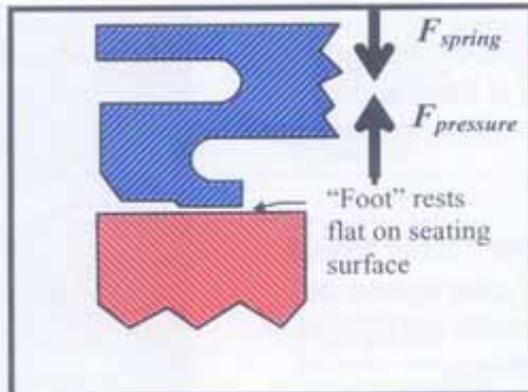
# MAIN STEAM SAFETY RELIEF VALVE

## FLEX-C™ DISC



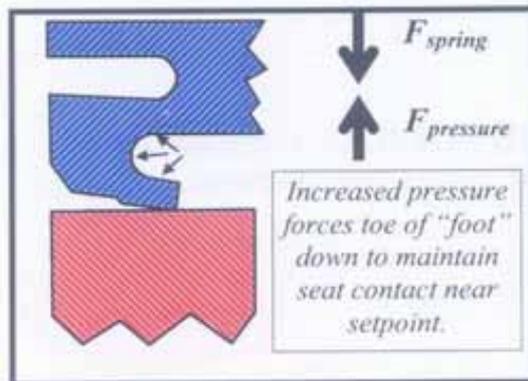
### *Zero Pressure*

With no pressure applied to the valve, the only force acting on the disc is the force of the return spring. This force is distributed across the disc in a manner that causes it to deform down into the seat so that the disc is actually seated on the "heel of the foot" on two different seating lines.



### *Normal Operating Pressure*

At normal operating pressure (10% below set) the disc is designed so that no deformation occurs. The "foot" is flat against the seat, providing a wide seating band that seals tight and is resistant to steam erosion. Note that the **FLEX-C™** configuration allows the disc to compensate for differences in temperature along its circumference.



### *Near Setpoint*

Near the valve setpoint, the increase in system pressure causes the internal **FLEX-C™** to flex outward, forcing the "toe of the foot" to maintain seat contact. This toe-to-seat seating line is closely controlled and provides a well defined effective seat area. The accuracy of this effective area translates to a highly accurate and repeatable setpoint.



PRODUCT MARCH 2002

# MAIN STEAM SAFETY RELIEF VALVE

## QUALIFICATIONS

1. Certified Flow by ASME National Board
2. Design Conformance and Durability Testing

Test Valve	Total # of Hot Cycles	Test Facility	Nameplate Set	Target Rock Test Report
ETV-2	182	Medium: Saturated Steam Flow: 1,000,000 lbs/hr Pressure: 1500 psig	1200	TRP 6385
ETV-3	578		1210	TRP 7189
ETV-4	132		1160	TRP 7145

### 3. Environmental Qualification

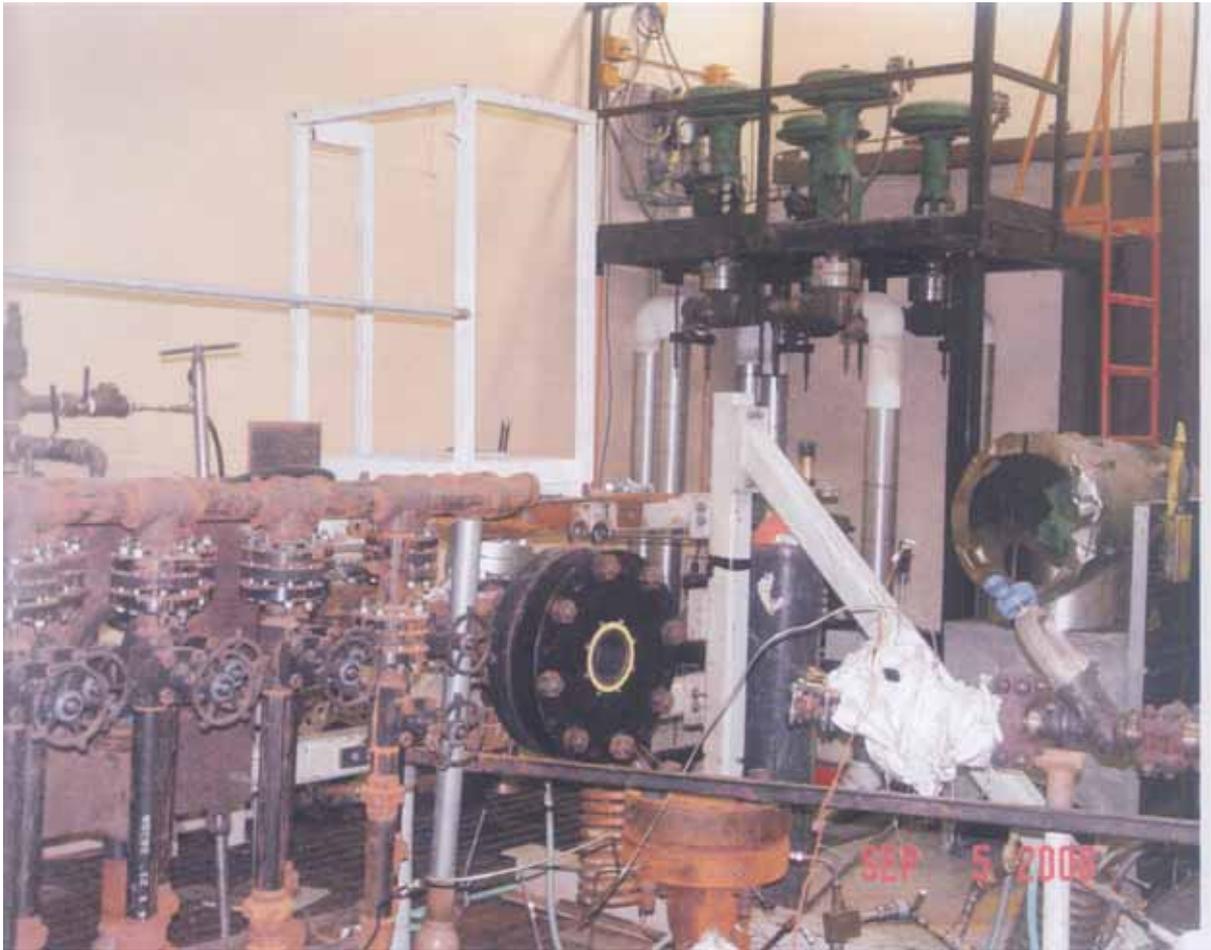
System: Main Steam		Function: Safety Relief		
Product: Safety Valve				
Manufacturer: Target Rock				
Model Number: 665-8x10-2132C1 and C2		Seismically Tested: Yes		
Parameter	Specification Requirement	Qualified Values	Qualification method	Required/ Actual Margin
Thermal Aging	5 years @ 135°F	258 hours @ 270°F	Test	10%/31%
Operating Time	100 days post DBE	110 days post DBE	Test/ Analysis	10%/10%
Peak Pressure, psig	45	49.5	Test	4.5 psig/4.5 psig
Peak Temp, F	340	355	Test	15 F/15F
Relative Humidity, %	100% RH	100%RH	Test	NA
Radiation: 40 year normal (rads)	1.22E6 (40 yr) 1.22E5 (4 yr)	1.38E+05	Test	10%/13%
Radiation: DBE (rads)	8.30E+06	9.39 E6		10%/13%
Aging Life (cycles)	3476	3547	Test	NA
Spray	Water 0.6 gpm/ft <sup>2</sup>	Water 0.6 gpm/ft <sup>2</sup>	Test	NA
Dynamic Loads:				
• Vibration	90 min. @ .75g	90 min. @ .75g	Test	N/A
• SRV Cycle Test	19 minutes	19 minutes	Test	10%/30%
• Upset Dynamic Test	5 cycles	5 cycles	Test	N/A
• Faulted Dynamic Test	1 cycle	1 cycle	Test	N/A
• Chugging Test	19 minutes	19 minutes	Test	N/A
• Seismic	RRS provided Faulted ZPA: 4.254 Long. 6.245 Vert. 5.451 Lat.	TRS > RRS for accelerations in frequency range of interest. Faulted ZPA: 6.8 Long. 7.1 Vert. 7.1 Lat.	Test/ Analysis	10%/30%



## Typical MSSRV Data Sheet

Typical MSSRV Data Sheet		
Identification	Description	<b>Main Steam Safety Relief Valve</b>
	Operation	Spring Over Disc and Air Operator
	Safety Function	Active
	Code	ASME Section III, Class 1 or Class 2
Service Requirements	Set Pressure	1100 psig to 1250 psig
	Accumulation	3%
	Blowdown	4% to 10%
	Superimposed Back Pressure	20% to 40% of set pressure
	Built-Up Back Pressure	150 psig
	Capacity	863,000 lb/hr to 979,000 lb/hr
Valve Body	Connecting Piping Size	8" x 10", 8" x 12"
	Body Material	Carbon Steel, ASME SA-350
	Inlet Connection	1500 # RF Flange
	Outlet Connection	300 # RF Flange
Trim	Disc Type	Flex-C™ Disc
	Nozzle Flow Diameter	4.850 in
	Trim Material	Disc: Inconel 718 Nozzle: 316 S.S. with Stellite Hardfacing
	Leak Rate	No Visible Leakage
Accessories	Manual Air Operator	Pneumatic cylinder fed by air amplifier.
	3-way Solenoid Operated Valves	Single, dual, or triple configuration of 3-way spool valves with individual amplifier stages for fast response time.
	Lifting Lever	No
	Position Switches	Magnetic reed switches with adjustable switch clamps

附錄 C. Target Rock 工廠測試設備參觀



測試設備全貌



測試座進口法蘭（盲封者）  
與出口法蘭

蒸汽蓄壓槽  
（小型，在隔板下方）





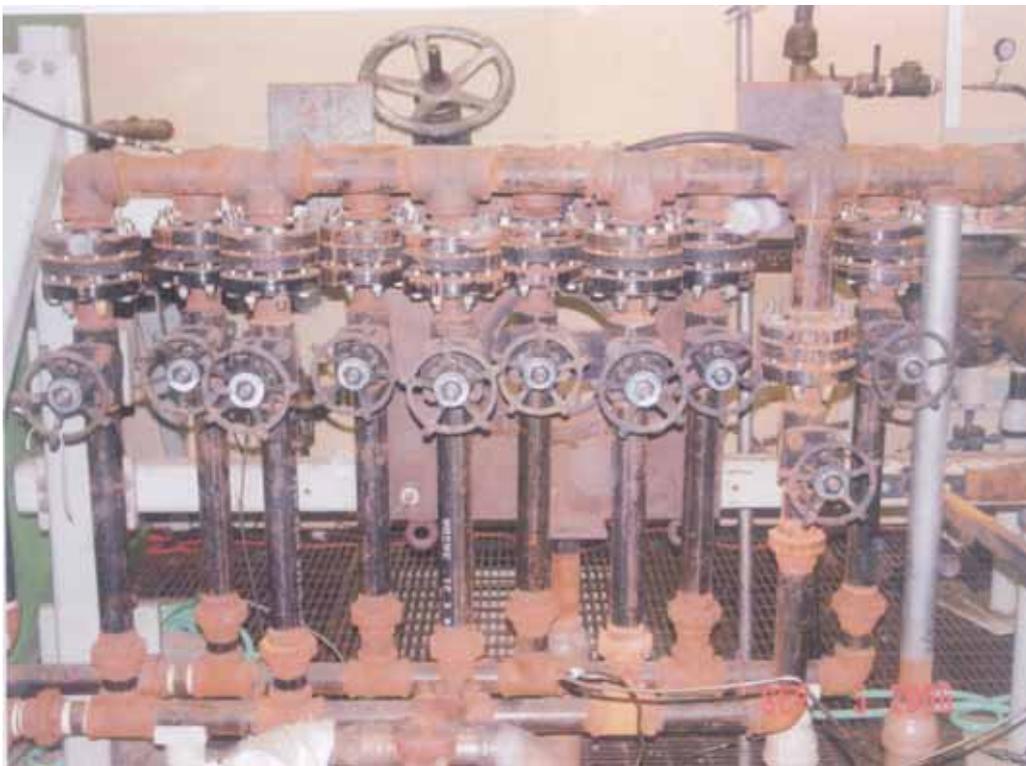
大型蓄壓槽

蒸汽出口管路與閥門





升溫升壓控制閥



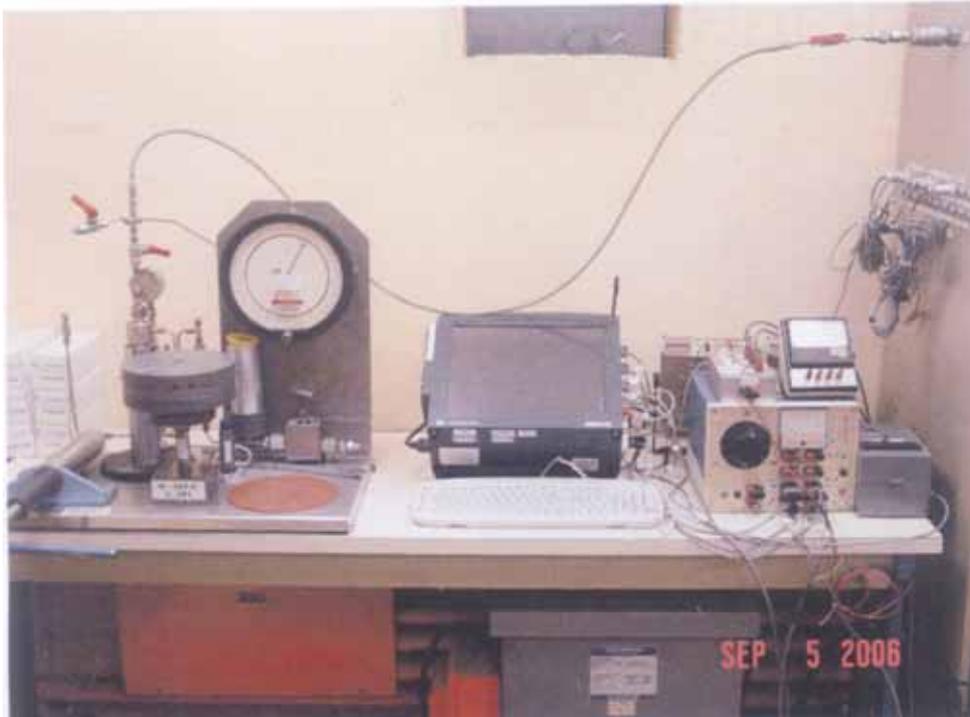
排氣端限流孔尺寸測定裝置



環境溫度控制箱



鍋爐



測試紀錄控制儀表



測試控制盤面

# Cooling Towers, Discharge Mufflers, Cooling Tower Pumps, and Piping



屋外大型冷卻水塔、冷卻水泵與管路

# 附錄D. Tyco International Inc. 公司介紹

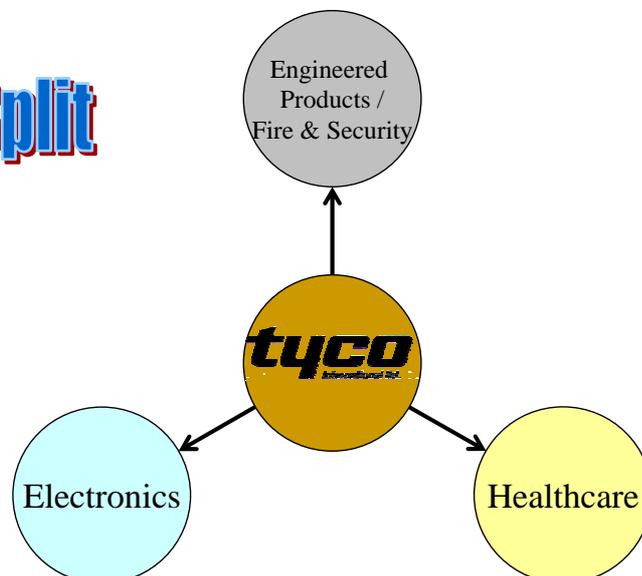


## Business Segments

Electronics	Engineered Products & Services	Fire & Security	Healthcare
			



## Corporate Split





## Tyco Engineered Products & Services

Electric & Metal Products	Fire & Building Products	Flow Control	Infra-structure Services	Thermal Controls
				

## **tyco** *flow control*

- World's premier manufacturers of flow control products.
  - Over 80 product brands
  - Expertise second-to-none
  - Innovative solutions to the most challenging flow control applications.

# tyco flow control



**CROSBY**

**ANDERSON  
GREENWOOD**



**SAPAG**

**vanessa**

**MORIN**

**INTERVALVE**



**Sempell**

**KEYSTONE**

**YARWAY**

**descote**

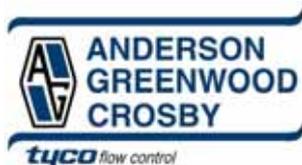
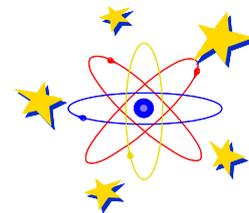
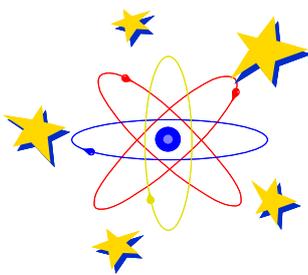
**GIMPEL**

**raimondi**

## Tyco Valves & Controls (Wrentham Facility)

- Wrentham Manufacturing Plant - Wrentham, MA USA

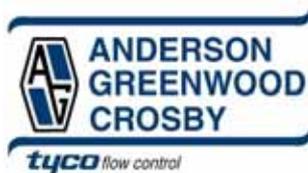
*“Nuclear Center of Excellence”*



# Tyco Valves & Controls (Wrentham Facility)

## Location

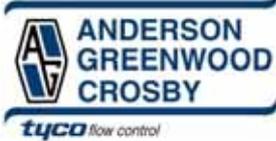
- Wrentham, MA  
35 miles SW of Boston



## Crosby Company History

- 1871 - Ashton Valve Co. founded (Cambridge, MA)
- 1874 - Crosby Steam Gage & Valve Co. founded (Charlestown, MA)
- 1920 - Spring Loaded safety valve developed
- 1945 - Stone family acquired Ashton and Crosby
- 1949 - Two companies merged and relocated to Wrentham, MA
- 1956 - Company name changed to Crosby Valve & Gage Co.
- 1971 - NV Certification
- 1981 - Crosby acquired by Geosource
- 1982 - Crosby UK licensee acquired
- 1984 - Crosby acquired by Moorco
- 1984 - Nuclear product (PORV) acquired from Garrett
- 1985 - Aberdeen Service Company (CSI)
- 1991 - Moorco becomes a public company
- 1991 - Crosby - Market Harborough achieves ISO 9002 Certification
- 1992 - Crosby - Wrentham achieves ISO 9001 Certification
- 1992 - Crosby - Aberdeen achieves ISO 9002 Certification
- 1993 - Crosby Valve Ptd. Ltd. established in Singapore
- 1994 - Crosby achieves vdTUV Certification
- 1995 - Moorco acquired by FMC
- 1997- Chinese Safety Quality License (SQL) awarded
- 1998 - Tyco International, Inc. acquired Crosby

# Tyco Valves & Controls (Wrentham Facility)

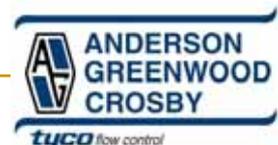


# Tyco Valves & Controls (Wrentham Facility)

- Wrentham Facility Statistics
  - **At present location since 1949**
    - Age of Buildings: 8–80 yrs
  - Footprint
    - **Lot Size: 21 Acres**
    - **Building Size: 200,000 Sq. Ft.**
      - Office: 45,000 Sq. Ft.
      - Manufacturing: 135,000 Sq. Ft.
      - Warehouse: 20,000 Sq. Ft.
  - Head Count: 91 Employees
    - **31 Direct**
    - **60 Exempt / Non Exempt**



\* excluding non-operational charges



# Tyco Valves & Controls (Wrentham Facility)

- Markets Served: Industry Focused vs. Product Focused

NUCLEAR POWER INDUSTRY	NAVY INDUSTRY
Commercial Nuclear Power Plant Applications (ASME Section III Safety Related)	U.S. Navy Applications on nuclear submarines and surface ships (secondary side)
<p>Products Sold:</p> Pressure Relief Valves, Hand Valves & Manifolds, Check & Globe Valves	<p>Products Sold:</p> Pressure Relief Valves, Check Valves, Strainers
<p>Customers:</p> End Users, Owner Operators, E&C's, OEM's	<p>Customers:</p> Government Contractors, End Users, OEM's



**Machining**



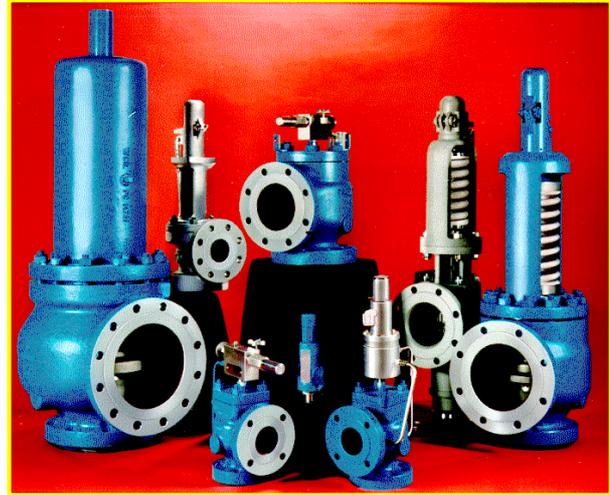
**Testing**

**Assembly**



# Crosby Products

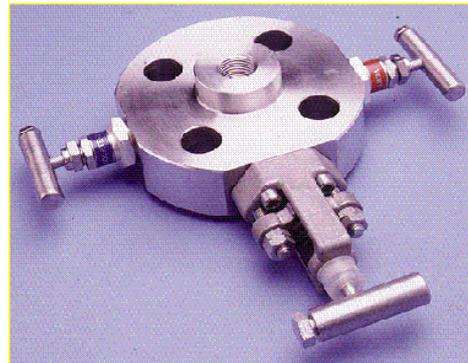
- **Pressure Relief Valves**
  - Spring Loaded
  - Pilot Operated
- **Specialty Products**



# Anderson Greenwood Products



# Anderson Greenwood Products



# Tyco Valves & Controls (Wrentham, Facility)

**Nuclear Center of Excellence**  
Wrentham, MA

**KEYSTONE**  
• Butterfly Valves

**VARWAY**  
• Wetbond - Globe Valves  
• Steam Traps  
• Strainers

**ANDERSON GREENWOOD**  
• Pressure Relief Valves  
• Instrumentation Valves  
• Check Valves

**CROSBY**



"World Leader in Pressure Relief Valve Technology"

**LONERGAN**  
Parts for:  
• Relief Valves  
• Direct Replacement Valves

**HANCOCK**  
• Globe Valves

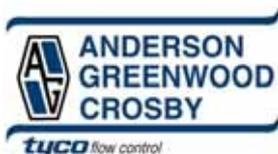
**HAMMELDAHL**  
• Control Valves

Can't find the original supplier for a safety related valve installed in your nuclear plant? Check with us at Tyco Valves & Controls - Wrentham Facility. As Crosby Valve we have been involved with nuclear electricity generation from the beginning and were the first valve company in the nation to be awarded the NV stamp. Now, as the Nuclear Center of Excellence, we continue our commitment to this critical component of our energy supply by expanding the safety valve products and services we offer the nuclear industry.

The familiar brand names shown are now provided from our Wrentham Facility in accordance with a full 10 CFR 50 Appendix B program or an approved commercial dedication program that is designed to meet the needs of your nuclear plant.

\* Steam Flows Sold and Sealed by APD/US (Raytheon)  
\*\* Sold through Ingham Technical Services (ITS)

For more information, contact the Wrentham facility 1-508-384-3121  
[www.crosbynuclear.com](http://www.crosbynuclear.com)



# Testing - Research and Development

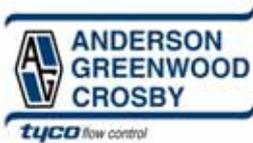


## Testing Capabilities

Over 120 years experience in pressure relief valve design, manufacturing and testing has developed at our Massachusetts and Texas locations the most sophisticated fluid test facilities in the world. Anderson Greenwood/Crosby's engineering team has designed testing equipment and procedures that assure optimum valve performance under service conditions encountered in the nuclear power industry.

## ASME - Accepted Testing Laboratory (Steam/Air/Water)

Integral part of the facilities is our flow laboratory for testing on steam, air and water.



# Tyco Valves & Controls (Wrentham, Facility)

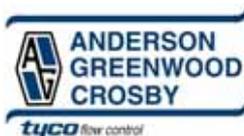
## Test Facilities:

### High Capacity Steam Loop

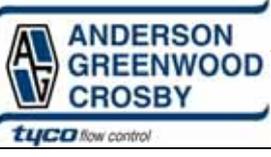
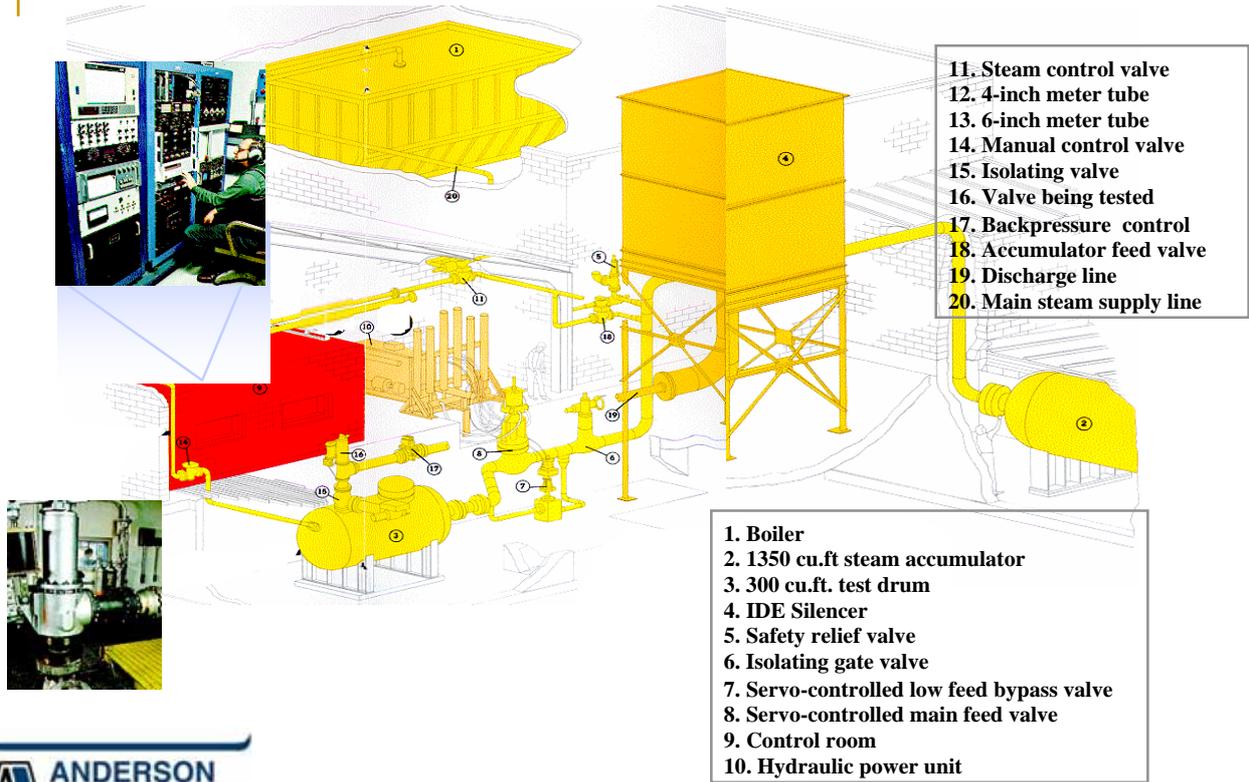
35,000 lb./hr Sustained 1500 psi  
2,000,000 lb/hr Short Duration

### ASME Accepted PRV Test Facility

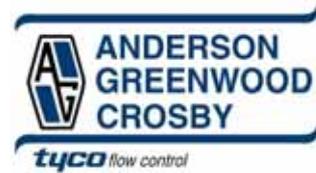
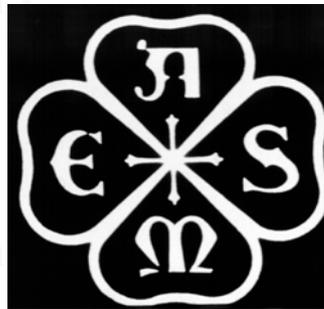
Steam	35,000 lb/hr	1550 psi
Air	9,000 SCFM	2250 psi
Water	300 GPM	300 psi



# High Flow Test Facility



# ASME Quality and Product Certifications



Section III



Section VIII

# Nuclear Products

**Pressure Relief Valves**

**Hand Valves & Manifolds**

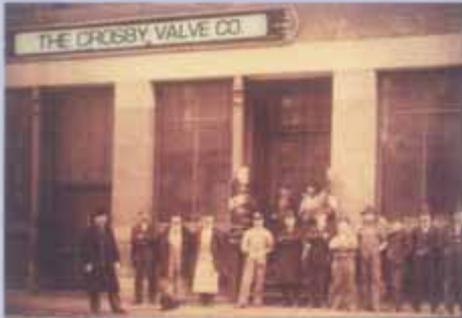
**Check & Globe Valves**

**Auxiliary Equipment**

**Services**



# Overpressure Protection - A History of Leadership



Crosby® founded as Valve and Instrument manufacturer. (1874)

Designed and supplied valves for Nautilus - first nuclear powered submersible. (1951)



Developed first full nozzle spring loaded safety valve. (1922)

Designed special two-phase flow valves for nuclear powered surface ships. (1962)



Developed large orifice pressure relief valves (PRV's) for turbine moisture-separator reheater service. (1968)



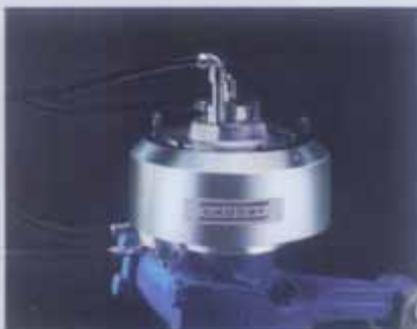
Provided pressure relief valves to all US reactor manufacturers and to EPRI for test programs. (1970's)



Participated in experimental NRC programs Loss Of Fluid Test (LOFT) and Fast Flux Test Facility (FFTF). (1978-80)



Developed an IEEE qualified direct reading position indicator for pressure relief valves. (1979)



Developed and patented automated *In Situ* set pressure verification device (SPVD) for Safety Valves. (1981)

Perfected the FLEXI-DISC® seat design for critical tightness applications. (1995)





## *Products*

- Pressure Relief Valves — Spring, Pilot and Power Operated
- Swing Check Valves
- Vacuum Relief Valves
- Hand Valves & Manifolds
- Globe Valves
- Valve Instrumentation
- Testing and Verification Devices

## *Capabilities*

- Valve design & selection assistance for new or upgraded applications.
- Development of new valves and instrumentation
- Performance and life cycle testing
- Test Programs — Consulting and Preparation

## *Customer Focused Support*

- Dedicated Nuclear Business Unit
- Technical support for special applications
- Rapid "turnaround" for plant emergencies
- Coordinate parts requirements for outages
- On-site technical assistance available

## *Services*

- Trained and qualified service personnel
- *In Situ* testing with computer driven calibrated assist devices
- Shop and Field repair, VR & NR stamps
- On-site repair and supervision
- Product and Maintenance training
- Stress Analysis / Seismic Analysis
- Contaminated valve repair and test

## *Testing, Research & Development*

- ASME/NB Accredited Flow Laboratories — Steam, Air & Liquid
- High Pressure — High Flow Steam Testing
- Cold Differential Test Pressure Evaluation (CDTP)
- Seismic Operability

## *Applications*

- Pressurizer Safety Valves
- Main Steam Safety Valves (MSSV)
- Balance of Plant PRV's
- Vacuum Breakers — MSSV downcomers
- Swing Checks — Containment Isolation
- Instrument Isolation Valves
- Valve Position Indication

*Engineering expertise backed with a full product line to upgrade performance or replace any valve.*

# Applications - Selection Matrix

## Pressure Relief Valves

Steam							
Valve Style	ASME Section	Blowdown		Balanced (Y/N)	Orifice		Page
		Adjustable	Fixed		< D	> D	
HB-BP-DF	III	X		Y		X	14
HB-BP	III	X		Y		X	14
HA	III	X		N		X	15
JPV-A*	VIII	X		N		X	15
JO*	III & VIII	X		N		X	10
JB*	III & VIII	X		Y		X	10
JOS	III & VIII	X		N		X	8
JBS	III & VIII	X		Y		X	8
Series 800	III & VIII	X		N	X	X	6
Series 900	III & VIII		X	N	X	X	6

\*Available in over "T" sizes

Air/Gas							
Valve Style	ASME Section	Blowdown		Balanced (Y/N)	Orifice		Page
		Adjustable	Fixed		< D	> D	
JO	III & VIII	X		N		X	10
JB	III & VIII	X		Y		X	10
JOS	III & VIII	X		N		X	8
JBS	III & VIII	X		Y		X	8
Series 800	III & VIII	X		N	X	X	6
Series 900	III & VIII		X	N	X	X	6
BP	VIII	X		Y	X	X	7
83	III & VIII	X		N	X	X	13
Pilot Series 9300	III & VIII	X		Y		X	16
VR	III		X	N	N/A	N/A	16

# Applications - Selection Matrix

## Pressure Relief Valves



### Liquid

Valve Style	ASME Section	Blowdown		Balanced (Y/N)	Orifice		Page
		Adjustable	Fixed		< D	> D	
JLT-JOS	III & VIII	X		N		X	9
JLT-JBS	III & VIII	X		Y		X	9
JWR-JO	III	X		N		X	11
JWR-JB	III	X		Y		X	11
JMB-WR	III & VIII	X		N	X		7
JMAK	III & VIII	X		N	X		12
Series 900	III & VIII		X	N	X	X	6
BP	III & VIII	X		Y	X	X	7
81P	III & VIII		X	Y	X		13
JRAK-BS	III & VIII	X		Y	X		12



Index	Page
Pressure Relief Valves .....	6-16
Hand Valves and Manifolds .....	17
Globe Valves and Check Valves .....	18
Testing and Verification Devices .....	19
Services .....	20
Test Facilities .....	21
Customer Support .....	22

# Products - Pressure Relief Valves



## Series 900 OMNI-TRIM®

The Crosby® Series 900 OMNI-TRIM is a conventional safety relief valve designed for use on steam, air, gas, and liquid service. Its single trim design provides stable operation on all service media. Precision flat metal to metal seats or elastomer o-ring soft seats provide exceptional seat tightness.

<b>Inlet Sizes:</b>	1/2" through 2" (12.7 mm through 50.8 mm)
<b>Outlet Sizes:</b>	1" through 2 1/2" (25.4 mm through 63.5 mm)
<b>Connection:</b>	Flanged, Threaded, and Welded
<b>Orifice Sizes:</b>	0.0551 sq. in. through 0.5674 sq. in. (35.6 sq. mm through 366.1 sq. mm)
<b>Set Pressure Range:</b>	15 psig through 5000 psig (1.03 barg through 344.8 barg)
<b>Temp Range:</b>	-450°F to +750°F (-267.8°C to +398.9°C)
<b>Materials:</b>	Stainless Steel; Alternate Materials Available
<b>Blowdown:</b>	Fixed blowdown design guarantees blowdown less than 20% (optional 10% blowdown design available)
<b>Service Media:</b>	Steam, Air, Gas, and Liquid
<b>ASME Code Capacity Certification:</b>	Section III & VIII
<b>Options:</b>	Soft Seat Design

Crosby Generic Design Specification DS-6103 available for safety related applications.

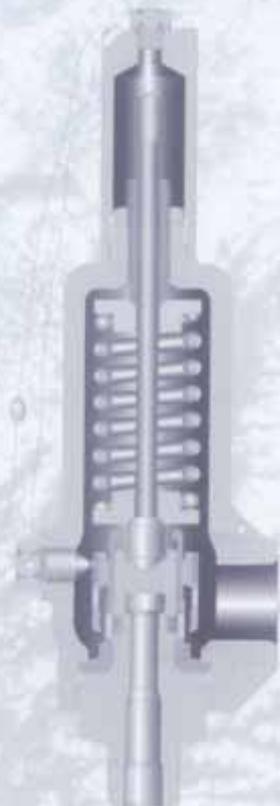
For complete details, capacities and sizes - see Catalog No. 902

## Series 800 OMNI-TRIM®

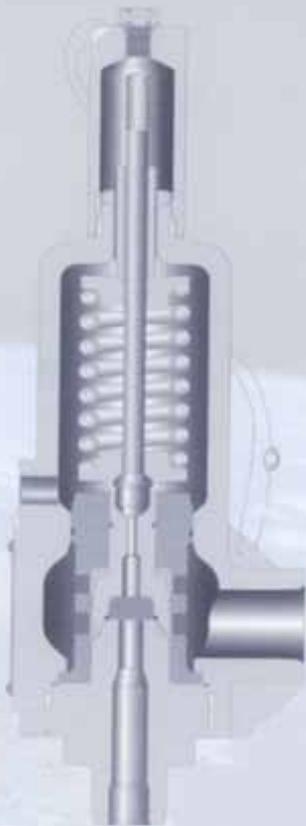
The Crosby Series 800 OMNI-TRIM is a conventional safety relief valve designed for use on steam, air and gas service. Its single trim design provides stable operation on all service media types. External precise blowdown control provides shorter blowdown than the Series 900.

<b>Inlet Sizes:</b>	1/2" through 2" (19.1 mm through 50.8 mm)
<b>Outlet Sizes:</b>	1" through 2 1/2" (25.4 mm through 63.5 mm)
<b>Connection:</b>	Flanged, Threaded, and Welded
<b>Orifice Sizes:</b>	0.1244 sq. in. through 0.5674 sq. in. (80.3 sq. mm through 366.1 sq. mm)
<b>Set Pressure Range:</b>	15 psig through 5000 psig (1.03 barg through 344.8 barg)
<b>Temp Range:</b>	-450°F to +750°F (-267.8°C to +398.9°C)
<b>Materials:</b>	Stainless Steel; Alternate Materials Available
<b>Blowdown:</b>	Adjustable Blowdown Control
<b>Service Media:</b>	Steam, Air and Gas
<b>ASME Code Capacity Certification:</b>	Section III & VIII
<b>Options:</b>	Soft Seat Design

For complete details, capacities and sizes - see Catalog No. 902



# Products - Pressure Relief Valves



## Series BP

The Crosby Series BP is a pressure relief valve designed for use on air, gas and liquid service. Its single trim design provides stable operation on multiple service media. The balanced piston design minimizes the effects of backpressure and prevents the process fluid from entering the spring chamber. An o-ring seat provides for optimum seat tightness and minimal maintenance.

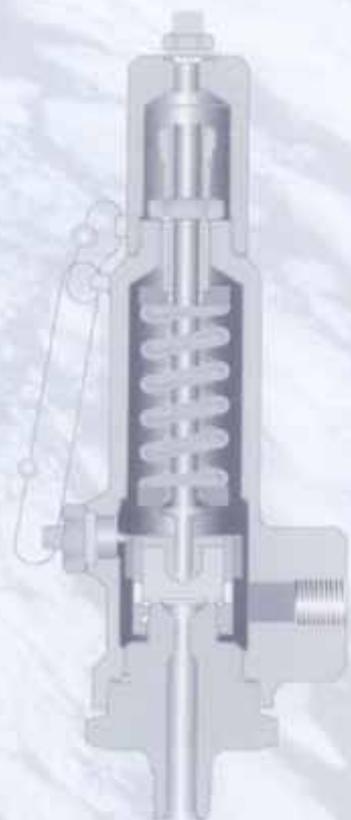
<b>Inlet Sizes:</b>	1/2" and 1" (19.1 mm and 25.4 mm)
<b>Outlet Sizes:</b>	1" (25.4 mm)
<b>Connection:</b>	Flanged, Threaded, and Welded
<b>Orifice Sizes:</b>	0.0539 sq. in. through 0.1364 sq. in. (34.8 sq. mm through 88 sq. mm)
<b>Set Pressure Range:</b>	15 psig through 1500 psig (1.03 barg through 103.5 barg)
<b>Temp Range:</b>	-20°F to +400°F (-28.9°C to +204.4°C)
<b>Materials:</b>	Stainless Steel; Alternate Materials Available
<b>Blowdown:</b>	Fixed blowdown design guarantees blowdown less than 25%
<b>Service Media:</b>	Air, Gas, and Liquid
<b>ASME Code Capacity Certification:</b>	Section III & VIII

For complete details, capacities and sizes - see Catalog No. 905

## JMB-WR

The Crosby Style JMB-WR is a conventional pressure relief valve designed for liquid service. Its water ring design provides stable non-chattering valve performance on incompressible fluid applications with adjustable blowdown control.

<b>Inlet Sizes:</b>	1/2" and 1" (19.1 mm and 25.4 mm)
<b>Outlet Sizes:</b>	1" (25.4 mm)
<b>Connection:</b>	Flanged, Threaded, and Welded
<b>Orifice Sizes:</b>	0.0120 sq. in. through 0.1098 sq. in. (7.7 sq. mm through 70.8 sq. mm)
<b>Set Pressure Range:</b>	15 psig through 2750 psig (1.03 barg through 189.7 barg)
<b>Temp Range:</b>	-75°F to +750°F (-59.4°C to +398.9°C)
<b>Materials:</b>	Stainless Steel; Alternate Materials Available
<b>Blowdown:</b>	Adjustable Blowdown Control
<b>Service Medium:</b>	Liquid
<b>ASME Code Capacity Certification:</b>	Section III & VIII



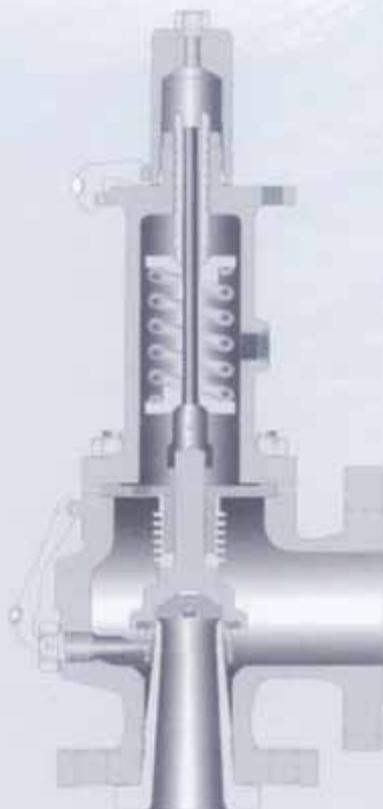
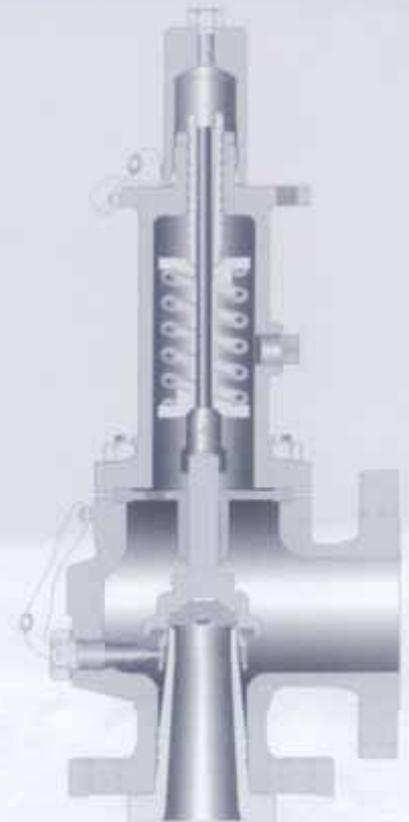
# Products - Pressure Relief Valves

## JOS

The Crosby Style JOS is a conventional pressure relief valve designed for use on steam, air and gas service. The valve is designed with a single nozzle ring control to assure optimum performance.

<b>Inlet Sizes:</b>	1" through 8" (25.4 mm through 203.2 mm)
<b>Outlet Sizes:</b>	2" through 10" (50.8 mm through 254 mm)
<b>Connection:</b>	Flanged
<b>Orifice Sizes:</b>	D through T2
<b>Set Pressure Range:</b>	15 psig to 6000 psig (1.03 barg to 413.8 barg)
<b>Temp Range:</b>	-450°F to +1000°F (-267.8°C to +537.8°C)
<b>Materials:</b>	Cast Carbon Steel or Stainless Steel with Stainless Steel Trim is Standard; Alternate Materials Available
<b>Blowdown:</b>	Adjustable Blowdown Control
<b>Service Media:</b>	Steam, Air and Gas
<b>ASME Code Capacity Certification:</b>	Section III & VIII
<b>Options:</b>	Soft Seat Design

For complete details, capacities and sizes - see Catalog No. 310



## JBS

The Crosby Style JBS is a balanced pressure relief valve designed for use on steam, air and gas service. The balancing bellows minimizes the effects of backpressure and prevents the process fluid from entering the spring chamber. The valve is designed with a single nozzle ring control to assure optimum performance.

<b>Inlet Sizes:</b>	1" through 8" (25.4 mm through 203.2 mm)
<b>Outlet Sizes:</b>	2" through 10" (50.8 mm through 254 mm)
<b>Connection:</b>	Flanged
<b>Orifice Sizes:</b>	D through T2
<b>Set Pressure Range:</b>	15 psig to 6000 psig (1.03 barg to 413.8 barg)
<b>Temp Range:</b>	-450°F to +1000°F (-267.8°C to +537.8°C)
<b>Materials:</b>	Cast Carbon Steel or Stainless Steel with Stainless Steel Trim is Standard; Alternate Materials Available
<b>Blowdown:</b>	Adjustable Blowdown Control
<b>Service Media:</b>	Steam, Air and Gas
<b>ASME Code Capacity Certification:</b>	Section III & VIII
<b>Options:</b>	Soft Seat Design

For complete details, capacities and sizes - see Catalog No. 310

# Products - Pressure Relief Valves

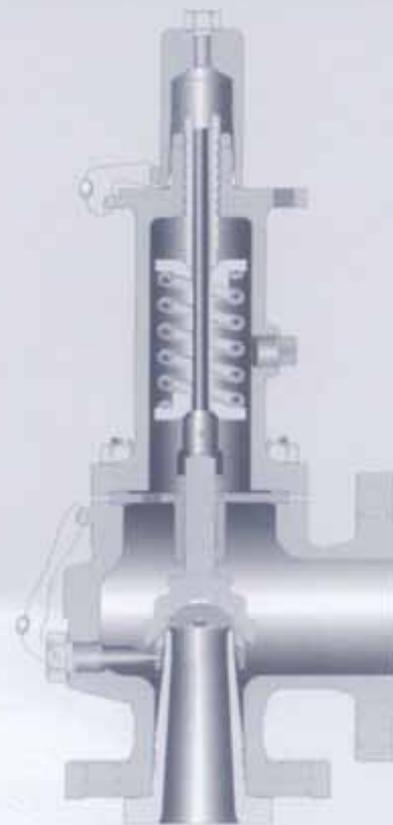


## JLT-JOS

The Crosby Style JLT-JOS is a conventional pressure relief valve designed for liquid service. Its unique internal trim provides stable non-chattering valve performance on incompressible fluid applications. This superior high performance valve has increased capacity at 10% overpressure that often permits the use of a smaller valve for the application.

<b>Inlet Sizes:</b>	1" through 8" (25.4 mm through 203.2 mm)
<b>Outlet Sizes:</b>	2" through 10" (50.8 mm through 254 mm)
<b>Connection:</b>	Flanged
<b>Orifice Sizes:</b>	D through T2
<b>Set Pressure Range:</b>	15 psig to 6000 psig (1.03 barg to 413.8 barg)
<b>Temp Range:</b>	-450°F to +1000°F (-267.8°C to +537.8°C)
<b>Materials:</b>	Cast Carbon Steel or Stainless Steel with Stainless Steel Trim is Standard; Alternate Materials Available
<b>Blowdown:</b>	Adjustable Blowdown Control
<b>Service Medium:</b>	Liquid
<b>ASME Code Capacity Certification:</b>	Section III & VIII
<b>Options:</b>	Soft Seat Design

For complete details, capacities and sizes - see Catalog No. 310

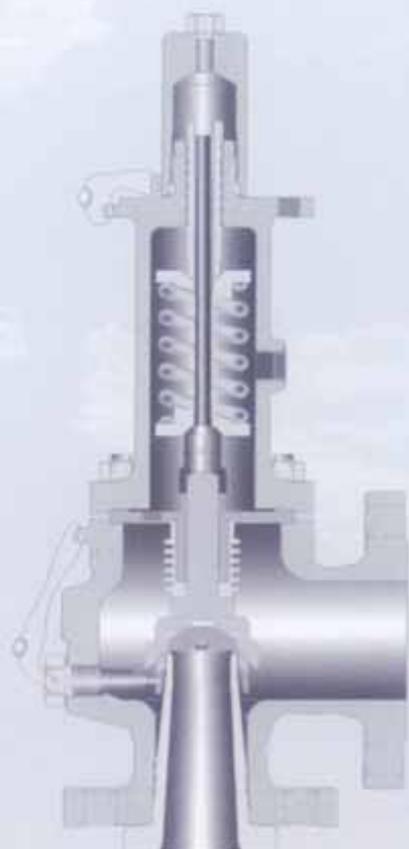


## JLT-JBS

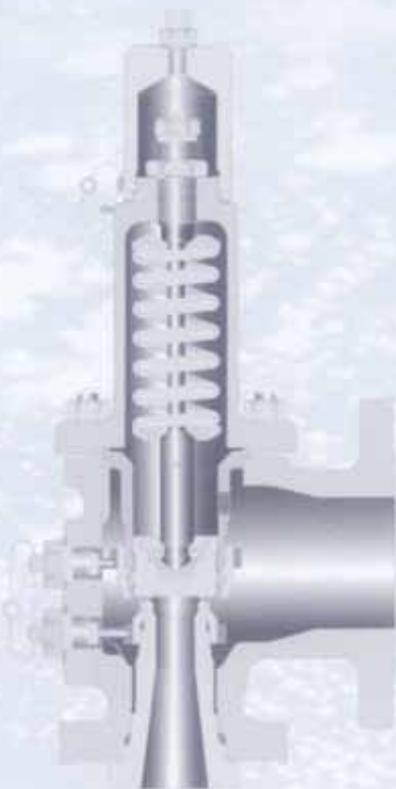
The Crosby Style JLT-JBS is a balanced pressure relief valve designed for liquid service. The balancing bellows minimizes the effects of backpressure and prevents the process fluid from entering the spring chamber. Its unique internal trim provides stable non-chattering valve performance on incompressible fluid applications. This superior high performance valve for liquid service has increased capacity at 10% overpressure that often permits the use of a smaller valve for the application.

<b>Inlet Sizes:</b>	1" through 8" (25.4 mm through 203.2 mm)
<b>Outlet Sizes:</b>	2" through 10" (50.8 mm through 254 mm)
<b>Connection:</b>	Flanged
<b>Orifice Sizes:</b>	D through T2
<b>Set Pressure Range:</b>	15 psig to 6000 psig (1.03 barg to 413.8 barg)
<b>Temp Range:</b>	-450°F to +1000°F (-267.8°C to +537.8°C)
<b>Materials:</b>	Cast Carbon Steel or Stainless Steel with Stainless Steel Trim is Standard; Alternate Materials Available
<b>Blowdown:</b>	Adjustable Blowdown Control
<b>Service Medium:</b>	Liquid
<b>ASME Code:</b>	Section III & VIII
<b>Options:</b>	Soft Seat Design

For complete details, capacities and sizes - see Catalog No. 310



# Products - Pressure Relief Valves



## JO

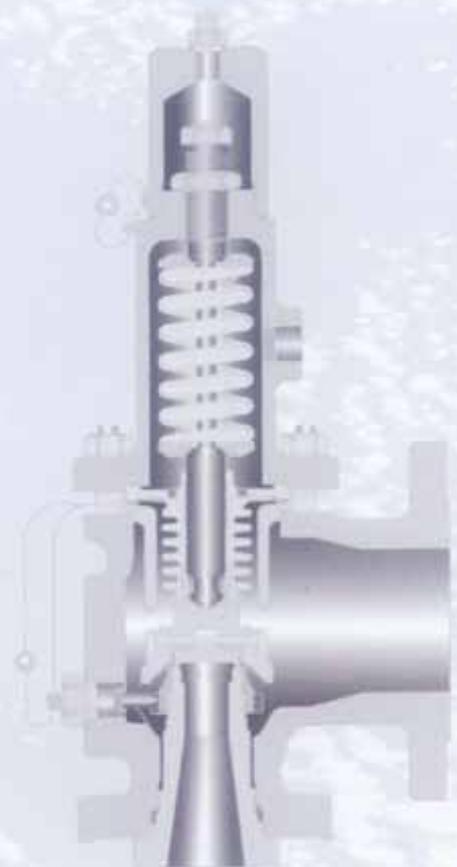
The Crosby Style JO is a conventional safety relief valve that provides two ring control for positive adjustment of both blowdown and pop action. The JO is designed for use on steam, air and gas service.

<b>Inlet Sizes:</b>	1" through 8" (25.4 mm through 203.2 mm)
<b>Outlet Sizes:</b>	2" through 10" (50.8 mm through 254 mm)
<b>Connection:</b>	Flanged
<b>Orifice Sizes:</b>	D through T
<b>Set Pressure Range:</b>	15 psig to 7500 psig (1.03 barg to 517.2 barg)
<b>Temp Range:</b>	-400°F to +1000°F (-240°C to +537.8°C)
<b>Materials:</b>	Cast Carbon Steel or Stainless Steel with Stainless Steel Trim is Standard; Alternate Materials Available
<b>Blowdown:</b>	Adjustable Blowdown Control
<b>Service Media:</b>	Steam, Air and Gas
<b>ASME Code Capacity Certification:</b>	Section III & VIII
<b>Options:</b>	Soft Seat Design

## JB

The Crosby Style JB is a balanced pressure relief valve that provides single ring control for positive adjustment of blowdown. The balancing bellows minimizes the effects of backpressure and prevents the process fluid from entering the spring chamber. The JB is designed for use on steam, air and gas service.

<b>Inlet Sizes:</b>	1" through 8" (25.4 mm through 203.2 mm)
<b>Outlet Sizes:</b>	2" through 10" (50.8 mm through 254 mm)
<b>Connection:</b>	Flanged
<b>Orifice Sizes:</b>	D through T
<b>Set Pressure Range:</b>	15 psig to 7500 psig (1.03 barg to 517.2 barg)
<b>Temp Range:</b>	-400°F to +1000°F (-240°C to +537.8°C)
<b>Materials:</b>	Cast Carbon Steel or Stainless Steel with Stainless Steel Trim is Standard; Alternate Materials Available
<b>Blowdown:</b>	Adjustable Blowdown Control
<b>Service Media:</b>	Steam, Air and Gas
<b>ASME Code Capacity Certification:</b>	Section III & VIII
<b>Options:</b>	Soft Seat Design

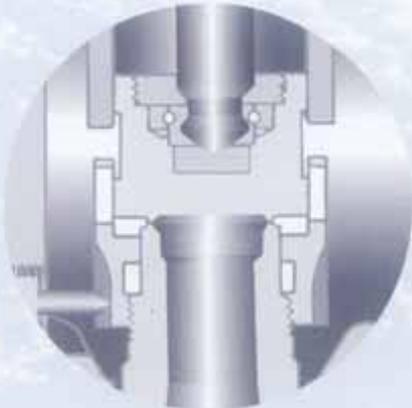


# Products - Pressure Relief Valves

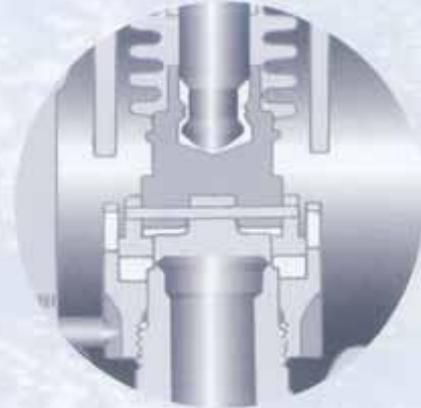


## JWR-JO & JWR-JB

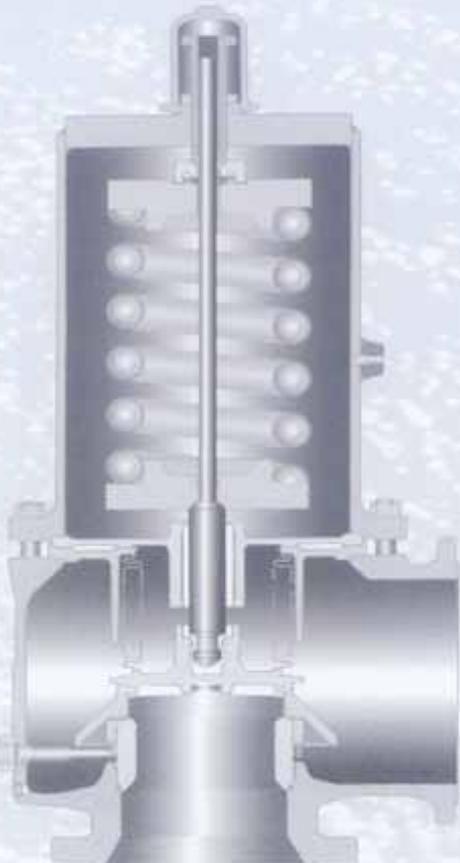
The Crosby JWR option is available in both the conventional JO and balanced JB designs. The JWR is a liquid trim design which provides stable operation with adjustable blowdown control.



JWR-JO



JWR-JB



## JO and JB “Over — T”

The JO and JB valve designs are also offered with orifice sizes greater than ‘T’ for applications with high flow rate requirements. The largest, with a capacity nearly seven times that of a ‘T’ orifice valve, can relieve over 3,000,000 lb/hr (1,360,800 kg/hr) steam at 300 psi (20.7 bar) pressure. Their dependability and performance has been proven by successful operation in nuclear power stations worldwide. A typical application in a nuclear power station is the moisture separator / reheater.

<b>Inlet Sizes:</b>	10" through 20" (254 mm through 508 mm)
<b>Outlet Sizes:</b>	14" through 24" (355.6 mm through 609.6 mm)
<b>Orifice Sizes:</b>	V (47.85 sq. in.) through BB2 (213.82 sq. in.) (30871 sq. mm through 137948 sq. mm)

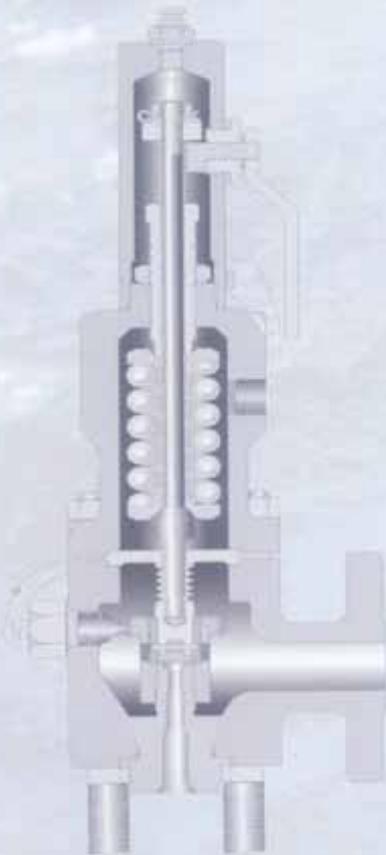
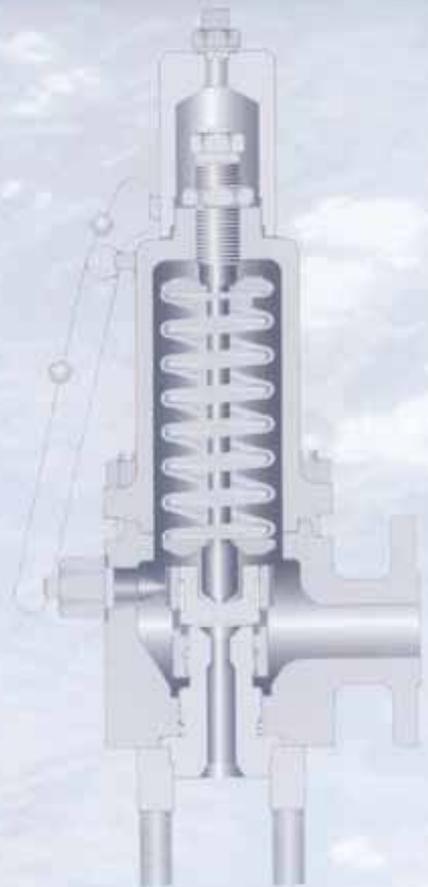
For complete details, capacities and sizes - see Catalog No. 307

# Products - Pressure Relief Valves

## JMAK

Crosby JMAK is a conventional relief valve designed for use on liquid service. Its small orifice design makes it ideal for low flow applications at high or low pressures. The water ring allows for adjustable blowdown control.

<b>Inlet Sizes:</b>	1/2", 3/4", 1" (12.7 mm, 19.1 mm, 25.4 mm)
<b>Outlet Sizes:</b>	1" (25.4 mm) and larger
<b>Connection:</b>	Flanged or Studded
<b>Orifice Sizes:</b>	0.012 sq. in. through 0.1098 sq. in. (7.7 sq. mm through 70.8 sq. mm)
<b>Set Pressure Range:</b>	5 psig through 2750 psig (0.35 barg through 189.7 barg)
<b>Temp Range:</b>	-75°F to +750°F (-59.4°C to +398.9°C)
<b>Materials:</b>	Stainless Steel: Alternate Materials Available
<b>Blowdown:</b>	Adjustable Blowdown Control
<b>Service Medium:</b>	Liquid
<b>ASME Code Capacity Certification:</b>	Section III & VIII



## JRAK-BS

Crosby JRAK-BS is a balanced relief valve designed for use on liquid service. The balancing bellows minimizes the effects of backpressure and prevents the process fluid from entering the spring chamber. Its small orifice design makes it ideal for low flow applications at high or low pressures. The water ring allows for adjustable blowdown control.

<b>Inlet Sizes:</b>	1/2", 3/4", 1" (12.7 mm, 19.1 mm, 25.4 mm)
<b>Outlet Sizes:</b>	1" (25.4 mm) and larger
<b>Connection:</b>	Flanged or Studded
<b>Orifice Sizes:</b>	0.012 sq. in. through 0.1098 sq. in. (7.7 sq. mm through 70.8 sq. mm)
<b>Set Pressure Range:</b>	25 psig through 3600 psig (1.72 barg through 248.3 barg)
<b>Temp Range:</b>	-75°F to +750°F (-59.4°C to +398.9°C)
<b>Materials:</b>	Stainless Steel: Alternate Materials Available
<b>Blowdown:</b>	Adjustable Blowdown Control
<b>Service Medium:</b>	Liquid
<b>ASME Code Capacity Certification:</b>	Section III & VIII

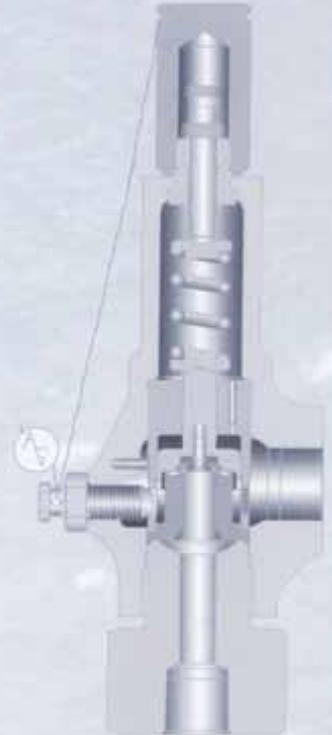
# Products - Pressure Relief Valves

## Series 83

The Series 83 direct operated safety relief valve, with an elastomer seat, is ideal for gas processes that operate close to the set pressure. It maintains tightness close to set pressure, opens fully at set pressure, and provides adjustment for short blowdown.

<b>Inlet Sizes:</b>	1/2" through 2" (12.7 mm through 50.8 mm)
<b>Outlet Sizes:</b>	1/2" through 2 1/2" (12.7 through 63.5 mm)
<b>Connection:</b>	Flanged, Threaded and Welded
<b>Orifice Sizes:</b>	0.049 sq. in. and 0.196 sq. in. (31.6 sq. mm and 126.5 sq. mm)
<b>Set Pressure Range:</b>	20 psig through 3000 psig (1.4 barg through 206.9 barg)
<b>Temp Range:</b>	-20°F to +500°F (-28.9°C to +260°C)
<b>Materials:</b>	Stainless Steel with EPR Seat: Alternate Materials Available
<b>Blowdown:</b>	Adjustable Blowdown Control
<b>Service Media:</b>	Air and Gas
<b>ASME Code Capacity Certification:</b>	Section III & VIII

For complete details, capacities and sizes - see Catalog No. 60/80



## Series 81P

The Series 81P is a soft seated, balanced, direct spring operated pressure relief valve designed for liquid applications. The spring chamber is isolated by the guide seal and the backpressure seal on the stem of the spindle, and vented to atmosphere. Thus, the valve remains fully balanced and operational.

<b>Inlet Sizes:</b>	1/2" through 2" (12.7 mm through 50.8 mm)
<b>Outlet Sizes:</b>	1/2" through 2 1/2" (12.7 through 63.5 mm)
<b>Connection:</b>	Flanged, Threaded and Welded
<b>Orifice Sizes:</b>	0.049 sq. in. and 0.196 sq. in. (31.6 sq. mm and 126.5 sq. mm)
<b>Set Pressure Range:</b>	50 psig through 2160 psig (3.5 barg through 149 barg)
<b>Temp Range:</b>	-20°F to +500°F (-28.9°C to +260°C)
<b>Materials:</b>	Stainless Steel With Non-Metallic Seat: Alternate Materials Available
<b>Blowdown:</b>	Fixed blowdown design guarantees blowdown less than 20%
<b>Service Medium:</b>	Liquid
<b>ASME Code Capacity Certification:</b>	Section III & VIII

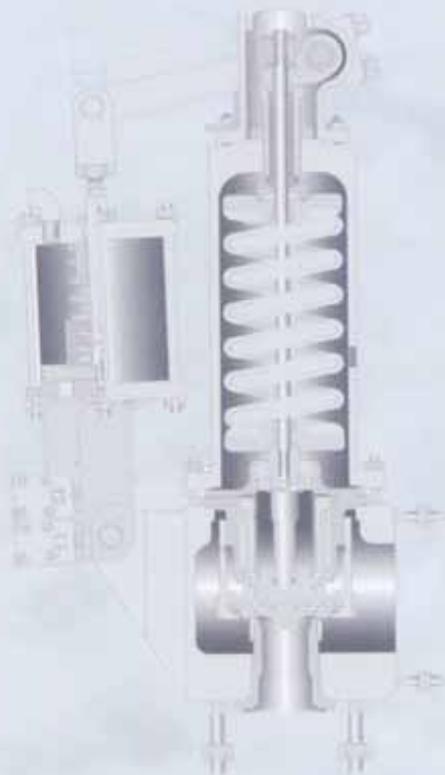
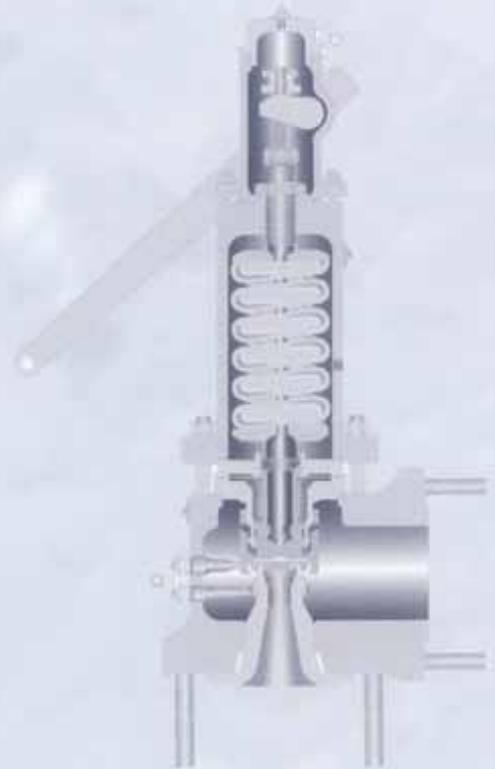
For complete details, capacities and sizes - see Catalog No. 60/80

# Products - Pressure Relief Valves

## Style HB-BP

The Crosby Style HB-BP is designed specifically to meet the exacting requirements of nuclear power plant applications where the valve is not allowed to discharge to atmosphere. The bellows 'balances out' the effects of high backpressure in the discharge system, assuring constant popping pressure despite variable backpressure. Crosby's patented eductor design controls the dynamic forces of the discharging fluid to stabilize valve performance. The valve provides full capacity, stable operation at backpressure up to 50% of the set pressure. This valve is used as the pressurizer safety valve in pressurized water reactors throughout the world.

<b>Inlet Sizes:</b>	3" through 6" (76.2 mm through 152.4 mm)
<b>Connection:</b>	Flanged or Studded
<b>Orifice Sizes:</b>	K through N
<b>Set Pressure Range:</b>	Up to 2500 psig (172.4 barg)
<b>Materials:</b>	Stainless Steel Body and Nozzle and Inconel™ Disc Insert
<b>Blowdown:</b>	Adjustable Blowdown Control
<b>Service Medium:</b>	Saturated Steam
<b>ASME Code Capacity Certification:</b>	Section III
<b>Optional Features:</b>	FLEXI-DISC® Seat Design BlockBody™ Design For Applications With High Discharge Piping Loads



## Style HB-BP-DF

The Crosby HB dual function safety valve fulfills the special overpressure safety requirements of boiling water reactor primary loops (where remotely controlled automatic steam blowdown valves are not used). The valve will pop automatically at the set pressure or may be opened by means of an electrical signal to one, two or three solenoid valves that actuate the air cylinder on the main steam valve. Mounted to the primary steam generator piping, the style HB dual function valve has similar construction and performance features to the HB pressurizer valve.

<b>Inlet Sizes:</b>	6" and 8" (152.4 mm and 203.2 mm)
<b>Connection:</b>	Flanged or Studded
<b>Orifice Size:</b>	R
<b>Set Pressure Range:</b>	Up to 1400 psig (96.6 barg)
<b>Materials:</b>	Forged Carbon Steel, Stainless Steel Nozzle and Inconel Disc Insert
<b>Blowdown:</b>	Adjustable Blowdown Control
<b>Service Medium:</b>	Saturated Steam
<b>ASME Code Capacity Certification:</b>	Section III
<b>Optional Features:</b>	FLEXI-DISC® Seat Design

\*Inconel is a registered trademark of the International Nickel Company, Inc.

# Products - Pressure Relief Valves



## Style HA

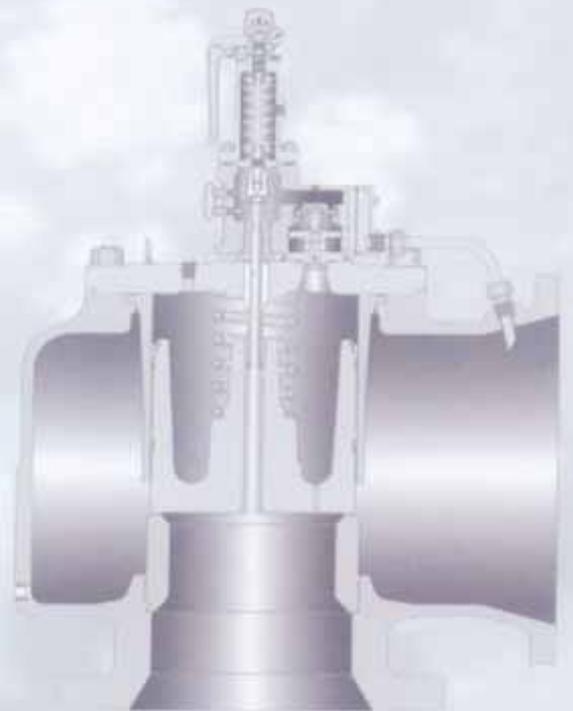
The Crosby Style HA has been designed for the exacting service and operating requirements of nuclear power plants. Style HA assures precise operation and continuing tightness plus ease of maintenance which characterizes Crosby safety valves. It is intended for service on pressurized water reactors as the main steam safety valve.

<b>Inlet Sizes:</b>	6" and 8" (152.4 mm and 203.2 mm)
<b>Connection:</b>	Flanged, Studded, Welded
<b>Orifice Sizes:</b>	Q through T
<b>Set Pressure Range:</b>	Up to 1400 psig (96.6 barg)
<b>Materials:</b>	Forged Carbon Steel/Stainless Steel Nozzle/ Inconel™ Disc Insert
<b>Blowdown:</b>	Adjustable Blowdown Control
<b>Service Medium:</b>	Saturated Steam
<b>ASME Code Capacity Certification:</b>	Section III
<b>Optional Features:</b>	FLEXI-DISC Seat Design Dual Outlet Design

## Style JPV-A

The Crosby Style JPV-A features a pressure loaded main valve actuated by a small spring loaded pilot which operates in response to system pressure. Style JPV-A valves provide the same advantages of superior operation, tightness and maximum ease of maintenance characteristic of Crosby spring loaded safety and relief valves. In addition, the use of a pressure loaded main valve disc in place of a spring loaded main valve disc assures maximum seat tightness up to the opening point of the valve.

<b>Inlet Sizes:</b>	10" through 20" (254 mm through 508 mm)
<b>Connection:</b>	Flanged
<b>Orifice Sizes:</b>	V through BB
<b>Set Pressure Range:</b>	50 psig through 300 psig (3.5 barg through 20.7 barg)
<b>Materials:</b>	Cast Carbon Steel or Stainless Steel
<b>Blowdown:</b>	Adjustable Blowdown Control
<b>Service Medium:</b>	Saturated Steam
<b>ASME Code Capacity Certification:</b>	Section VIII
<b>Optional Features:</b>	Soft Seat



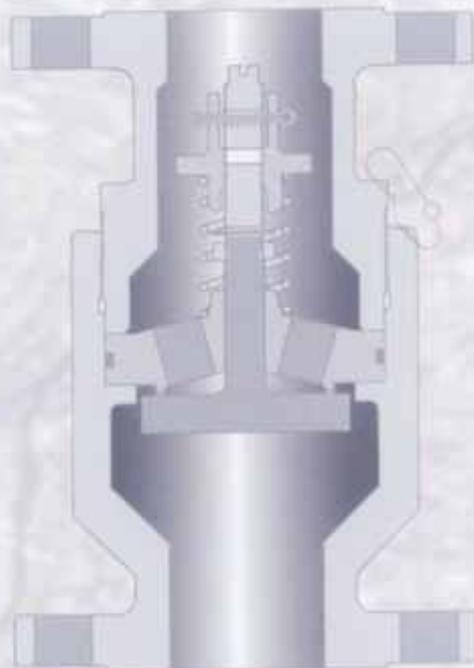
For complete details, capacities and sizes - see Catalog No. 307

# Products - Pressure Relief Valves

## VR

The Crosby Style VR is a safety relief valve designed for vacuum relief applications. Vacuum relief valves, provided with metal or soft seats, protect piping and vessels when operating pressure is suddenly reduced because of system malfunction.

<b>Inlet/Outlet Sizes:</b>	1" through 10" (25.4 mm through 254 mm)
<b>Connection:</b>	Flanged
<b>Set Pressure Range:</b>	-0.1 psig through -7 psig (-0.007 barg through -0.48 barg)
<b>Materials:</b>	Stainless Steel
<b>Service Media:</b>	Air and Gas
<b>ASME Code:</b>	Section III



## Style 9300

The Style 9300 pilot operated pressure relief valve employs the highly successful pressurized Teflon® film seat, as well as protected FEP diaphragms. This design allows these valves to be used in the pilot operated pressure relief mode, vacuum relief mode or both modes simultaneously.

<b>Inlet Sizes:</b>	2" through 12" (50.8 mm through 304.8 mm)
<b>Connection:</b>	Flanged
<b>Orifice Sizes:</b>	3.35 sq. in. to 113.097 sq. in. (2161.3 sq. mm to 72965.7 sq. mm)
<b>Set Pressure Range</b>	
<b>Positive Pressure Relief:</b>	4" wc to 50 psig (101.6 mm wc to 3.5 barg)
<b>Vacuum Relief:</b>	-4" wc to -5 psig (-101.6 mm wc to -0.35 barg)
<b>Materials:</b>	Stainless Steel
<b>Service Medium:</b>	Air and Gas
<b>ASME Code:</b>	Section III & VIII
<b>Options:</b>	Elastomer or Teflon Pilot Seat and Seals Available

For complete details, capacities and sizes - see Catalog No. 90/9000

\*Reg. U.S. Patent Office for DuPont's Fluorocarbon resins.

# Products - Hand Valves & Manifolds

Anderson Greenwood is the industry leader in instrument valve technology and innovator of the three-valve manifold. Anderson Greenwood / Crosby continues this excellence by supplying a full line of hand and manifold valves to the nuclear industry. Instrument valves are used in the isolation, equalization, and drain functions of the measurement and control instruments for process pressure, flow, and level monitoring.

## Style H7HS Series Hand Valve

The Style H7HS Series Hand Valve is designed for safe, repetitive bubble-tight closure, simple maintenance, and a long, trouble-free life. The free-swiveling ball end stem is incorporated for bubble-tight closure.

**H7HS Sizes:**

1/2", 3/4" and 1" (12.7 mm, 19.1 mm, 25.4 mm)

**H7HS Connection:**

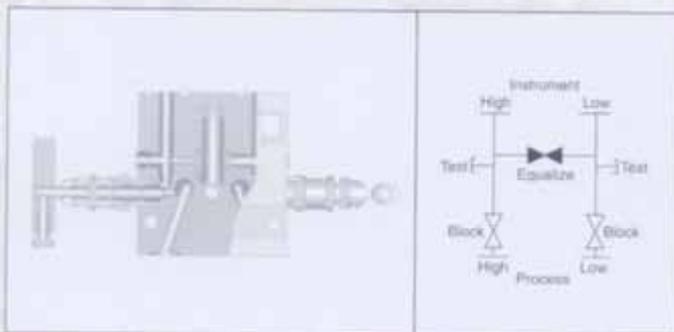
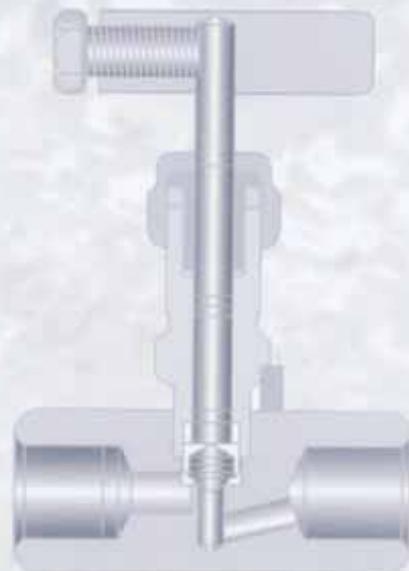
Threaded, Tube, Pipe Socket Weld

**Max. Design Pressure Rating:**

ANSI 2500#

(6000 psi @ +100°F and 3460 psi @ +800°F)

(413.8 bar @ +37.8°C and 238.6 bar @ +426.7°C)



## Style MIHS

The Style MIHS is a three-valve manifold designed to connect the signal lines and instruments such as recording orifice meters, small differential pressure indicators, and some differential pressure switches.

**MIHS Sizes and Connections:**

Standard Industry Connections.  
Consult Factory for Specific  
Details.

**Max. Design Pressure Rating:**

ANSI 1500#

(3600 psi @ +100°F and

2075 psi @ +800°F)

(248.3 bar @ +37.8°C and

143.1 bar @ +426.7°C)

## Style DPMHS

The Style DPMHS is a five valve manifold designed for remote mounting to differential pressure transmitters. Lightweight and with compact dimensions, the DPMH manifold enables instrument operation, isolation, zeroing and venting in a single unit.

**DPMHS Sizes and Connections:**

Standard Industry Connections.  
Consult Factory for Specific  
Details.

**Max. Design Pressure Rating:**

ANSI 2500#

(6000 psi @ +100°F and

3460 psi @ +800°F)

(413.8 bar @ +37.8°C and

238.6 bar @ +426.7°C)

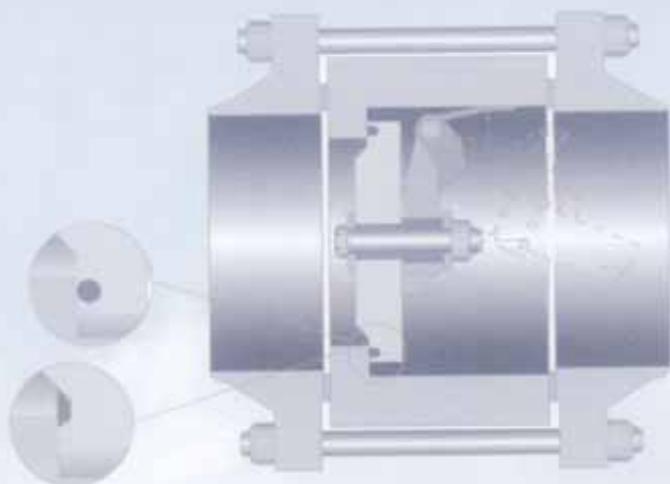
All valves made of stainless steel with Graphoil® packing and are manufactured to ASME Code Section III.

Generic Section III Design Specification was developed to support the "Redi Nuclear" Program which allows for Section III Class 2 and 3 valves to be stocked for immediate delivery.

\*Product of Union Carbide Corp.

For complete details, capacities and sizes - see Catalogs  
No. HV-US-98 and No. MC-US-98

# Products - *Globe & Check Valves*



## CV1B

The Model CV1B is a wafer style body, swing check valve designed for use as a check valve to prevent flow in one direction. When equipped with an extra lightweight disc and low force spring, the CV1B can be used for vacuum breaker applications. For applications where exceptional tightness is required, a replaceable elastomer seat is used. The CV1B meets the strict requirements of ASME Section III, Class 1, 2, or 3 to the year and applicable addenda determined by the customer. The CV1B can be supplied with or without the "N" stamp.

### Swing Check Applications

**Sizes:** 2" through 36"  
(50.8 mm through 914.4 mm)

**Connection:** Mounts between  
ANSI Class 150 to 1500

### Vacuum Breaker Applications

**Sizes:** 2" through 10"  
(50.8 mm through 254 mm)

**Connection:** Mounts between  
ANSI Class 150 or 300

**Opening Point:** 0.2 psig (0.014 barg)

**Full Open:** 0.5 psig (0.035 barg)

## Y12 Bellows Sealed Globe Valve

The Y12 Bellows Sealed Globe Valve is designed for applications where process fluid leakage to the environment is unacceptable. The stem is connected directly to the valve disc, providing positive, controlled operation. Its multi-stage design provides for a high flow coefficient.

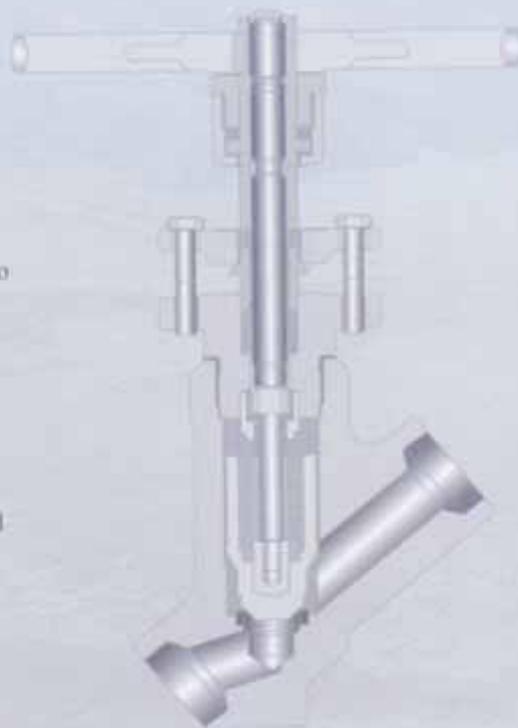
**Sizes:** 1/2" through 2"  
(12.7 mm through 50.8 mm)

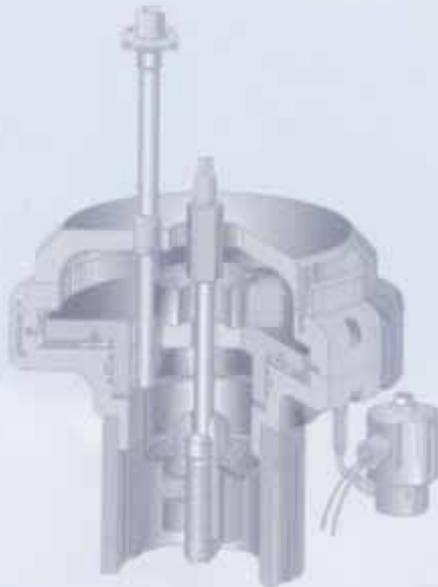
**Connection:** Socket Weld

**Pressure Classes:** ANSI Class 150 through 1500

**Materials:** Stainless Steel or Carbon Steel Body and Bonnet Assembly with Inconel Bellows

**ASME Code:** Section III



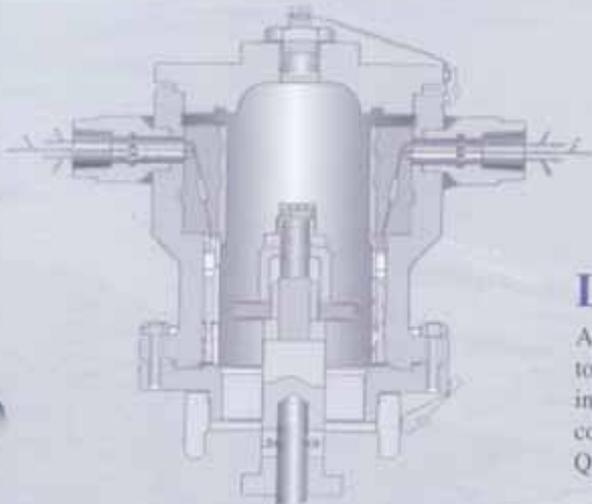


## SPVD-Set Pressure Verification Device

A system for in situ testing, classified as a "calibrated assist device" per ASME Performance Test Code (PTC 25). Totally automatic - computer driven system for testing safety valves. Available in portable or permanently mounted models.

## VPI-Valve Position Indicator

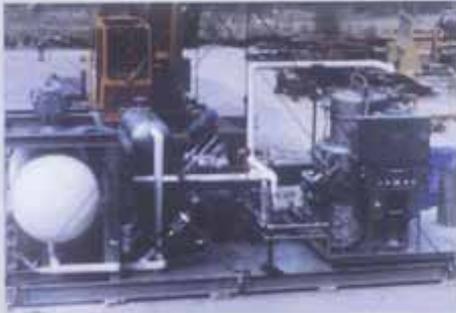
Provides direct, continuous, remote indication of valve spindle position. Permits safe monitoring of pressure relief valves located in hostile environments. Transducer is qualified - Class 1E Standard system handles up to 20 Linear Variable Differential Transducers (LVDT) Sensors. Qualified to IEEE-344 for in-containment service.



## LISA-Lift Indicating Switch Assembly

A valve position indicating device with a movable permanent magnet attached to the valve spindle. Fixed "reed" type switches are permanently encased in epoxy in the switch housing. Two sets of switches provide redundancy, with each set consisting of three switches indicating valve closed, mid and full open positions. Qualified to IEEE-344.

# Services



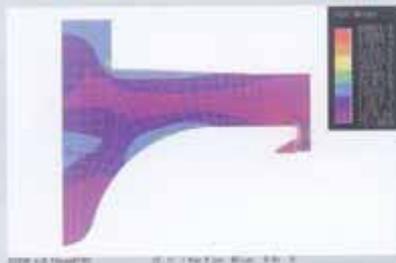
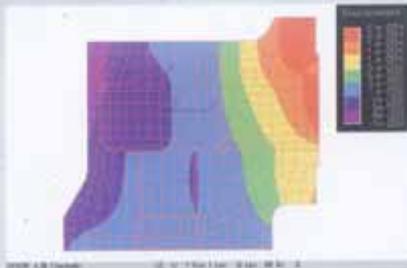
## Test Systems -

Custom designed for special testing of PRV's including Cold Differential Test Pressure (CDTP) verification.



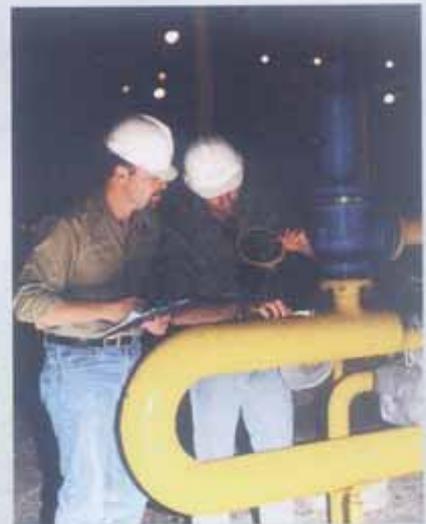
## Outage Planning Assistance -

Multiple resources available to minimize downtime during maintenance & refueling outages.



## Engineering Support -

- Assist in sizing & selection of PRV's for any application.
- ASME Code reconciliation.
- Stress and finite element analysis.
- Seismic analysis and testing.
- Design and management of valve testing programs.



## Product and Maintenance Training -

Seminars & hands-on training on-site or at Anderson Greenwood / Crosby facilities.

## Aftermarket and Field Service Support -

Qualified Technicians are strategically located worldwide for on-site repairs or supervision. Anderson Greenwood / Crosby holds VR & NR stamps for in-house shop and field work. Additional services include partnerships with industry approved laboratories.

# Testing - Research & Development



## Testing Capabilities

Over 120 years experience in pressure relief valve design, manufacturing and testing has developed at our Massachusetts and Texas locations the most sophisticated fluid test facilities in the world. Anderson Greenwood / Crosby's engineering team has designed testing equipment and procedures that assure optimum valve performance under service conditions encountered in the nuclear power industry.

## ASME-Accepted Testing Laboratory (Steam/ Air)

- An integral part of the facilities is our flow laboratory for testing on steam and air.
- Steam is generated by two package-type boilers having a 1500 psi (103.5 bar) design pressure and a rated capacity of 20,000 lb. (9072 kg) per hour of saturated steam. Steam flow is measured by a flow meter or direct condensate weighing.
- Compressors provide air up to 3000 psi (206.9 bar). Air is stored in a bank of accumulators at 2250 psi (155.2 bar) which charge the ASME test stand. Capacity is sufficient for functional and flow testing of valves as well as testing of components and other equipment.



## High Flow Test Facility (Steam)

- The high flow test loop is one of the largest and most sophisticated in the world. The facility has a sustained flow capacity of 20,000 lb. (9072 kg) per hour of saturated steam and capable of short duration flows to 2,000,000 lb. (907200 kg) per hour.
- The facility features a 300 cubic foot (8.5 cubic meter) test drum, a 1350 cubic foot (38.2 cubic meter) accumulator, a 12-inch (304.8 mm) servo-controlled hydraulically operated valve controlling steam flow to the test drum, and a fully instrumented control room.
- Capability of full flow testing "T" orifice HA or HB valves for short durations.

## ASME Accepted Testing Laboratory (Water)

- Laboratory consists of two independent flow loops.
- A low pressure loop, 300 psig (20.7 barg) max., utilizing a 300 gpm (1135.5 liters/min.) centrifugal pump and a 130 cubic foot (3.7 cubic meter) tank.



# Customer Support



*Dedicated Business Unit*

*Access to Performance Data*



*On-Line Availability*

*Industry Leadership*



*Experienced Staff*

*24 Hour Support*

*Solution-Based*



# A World of Safety - *In Every Detail*



Anderson Greenwood / Crosby has pioneered the development and application of valves and associated instrumentation to the world wide nuclear industry. This leadership role continues by providing the products and solutions that help safeguard the industry while enhancing performance - impacting your "bottom-line".

Specially engineered products have been designed and manufactured for experimental and prototype reactors, shipboard propulsion systems, and commercial electric generating plants.

A dedicated Nuclear Engineering staff is devoted to provide new or modified products as operating plants are upgraded.

New products continue to be developed to meet enhanced performance requirements of advanced reactors that are now under construction or being designed.

