



Enforcement Alert

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Facilities Urged to Review Systems for Risk of Check or Butterfly Valves Safety Hazards

On June 22, 1997, a serious chemical accident occurred at the Shell Chemical Company in Deer Park, Texas, 15 miles east of Houston. The accident resulted in injuries to several workers and extensive damage to the Shell Plant, as well as minor damage to nearby residential property. Damage

to the facility was estimated at \$101 million and major transportation routes were closed for several hours.

As a result of the Shell accident, the U.S. Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration (OSHA) released a joint accident investigation report, the "Shell Report" (June 19, 1998) to determine the root cause and contributing factors of the accident, and to make recommendations to prevent similar accidents.

In their report, EPA and OSHA determined that the immediate cause of the accident was the internal structural failure and drive shaft blow-out of a 36-inch diameter pneumatically-assisted Clow Model GMZ check (non-return) valve. Check and butterfly valves are used in refineries, petrochemical plants, chemical plants, and power generation facilities to stop and control the flow (e.g., prevent reversal of the flow's direction) of process materials through pipelines or apertures. According to the Shell Report, the check valve's failure resulted in a large flammable gas leak, forming a vapor cloud that ignited.

This issue of *Enforcement Alert* highlights key operational and design factors that may result in failures to check and butterfly valves as reported in a *Chemical Safety Alert* issued by EPA's Office of Chemical Emergency Preparedness and Prevention Office in September 1997, and as described in the Shell Report. This issue also includes recommendations contained in the Shell

*The Clean Air Act's
'General Duty
Clause' Requires
Owners and Operators
of Stationary Sources
to Identify, Prevent,
Minimize Accidental
Releases of Hazardous
Substances.*

Report to prevent similar accidents from occurring.

In addition, this issue focuses on the obligation that owners and operators of stationary sources have to identify, prevent and minimize accidental releases of hazardous substances under the Clean Air Act's "General Duty Clause."

Design Factors Contributing to a Shaft Blow-Out

The *Chemical Safety Alert* provides an expansive and technical discussion of factors that may contribute to a shaft blow-out from check or butterfly valves. These design factors include:

- The valve has a shaft or stem piece that penetrates the pressure boundary and ends inside the pressur-

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About

Enforcement Alert

"*Enforcement Alert*" is published periodically by the Office of Regulatory Enforcement to inform and educate the public and regulated community of important environmental enforcement issues, recent trends and significant enforcement actions.

This information should help the regulated community anticipate and prevent violations of federal environmental law that could otherwise lead to enforcement action.

See Page 3 for useful EPA Websites and additional resources.

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ized portion of the valve. This feature results in an unbalanced axial thrust on the shaft that tends to force it (if unconstrained) out of the valve.

- The valve contains potential internal failure points, such as shaft dowel-pins, keys, or bolts such that shaft-disk separation can occur inside the valve.

- The dimensions and manufacturing tolerances of critical internal parts (e.g., keys, keyways, pins, and pin holes) as designed or as fabricated cause these parts to carry abnormally high loads.

- The valve stem or shaft is not blow-out resistant. Nonblow-out resistant design features may include two-piece valve stems that penetrate the pressure boundary (resulting in a differential pressure and unbalanced axial thrust), single diameter valve shafts (i.e., a shaft not having an internal diameter larger than the diameter of its packing gland) or shafts without thrust retaining devices, such as split-ring annular thrust retainers.

Operational Factors Leading to a Valve Failure

According to the *Chemical Safety Alert*, operational factors that may lead to potential check or butterfly valve failure include:

- The valve is subject to high cyclic loads.

- The valve is subject to low or unsteady flow conditions such that disk flutter or chatter occur, resulting in increased wear of keys, dowel pins or other critical internal components.

- Valves in high-pressure service lines may be more likely to undergo shaft blow-out.

How to Obtain the Shell Report and EPA's *Chemical Safety Alert*

The Shell Report can be found on the Internet at <http://www.epa.gov/ceppo/acc-his.html> or a copy may be obtained by calling 1-800-490-9198. EPA's *Chemical Safety Alert* is also on the Internet at <http://www.epa.gov/ceppo/pubs/shell.pdf>.

- Valves used in hydrogen-rich or hydrogen sulfide-containing environments may be more susceptible to blow-out due to hydrogen embrittlement of critical internal components, particularly if these are made from hardened steel.

Shell Report Recommendations

The Shell Report includes recommendations that are designed to prevent a recurrence of an event similar to the Shell accident.

One primary recommendation made in the Shell Report is that companies

should review their process systems to determine if installed valves may be subject to a shaft blow-out hazard, and modify or replace those valves as necessary.

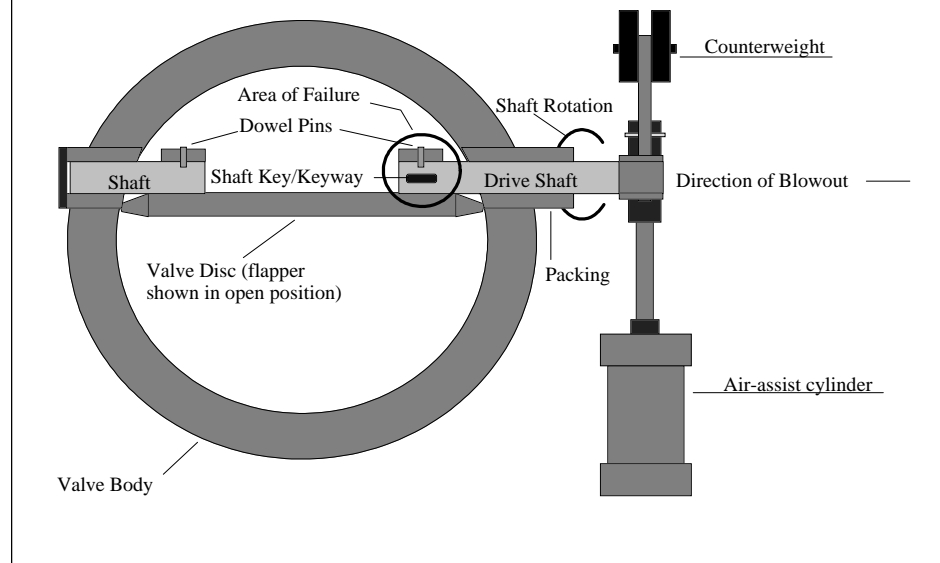
The report also recommends that facilities should consult valve manufacturers or other appropriate design authorities to ensure that any modifications made are safe.

Clean Air Act's 'General Duty Clause'

As part of the 1990 Clean Air Act

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Simplified cross-sectional view of check valve (flow's direction is into page)



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Amendments (CAA), Congress directed EPA to establish a program designed to prevent accidental releases of certain hazardous chemicals. Congress also enacted Section 112(r)(1) of the CAA (the "General Duty Clause"), which places a statutory obligation on owners and operators of stationary sources. Specifically, the General Duty Clause requires owners and operators of stationary sources to anticipate, prevent and minimize the effects of accidental releases whenever extremely hazardous substances are present (i.e., produced, processed, handled or stored) at the facility.

Owners and operators can take steps to reduce the likelihood of an accidental release and potential liability under the General Duty Clause by:

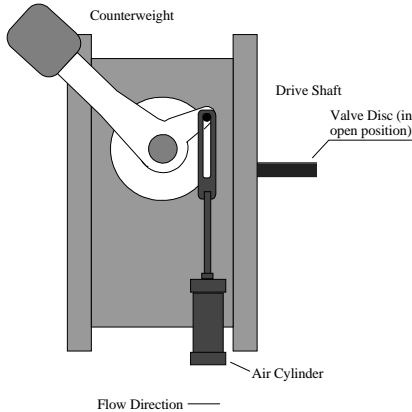
- Identifying and managing hazards associated with these check and butterfly valves.
- Designing and maintaining a safe facility to prevent accidental releases by, among other things, implementing a rigorous mechanical integrity program for valves in extreme service or with a known history of failure.
- Minimizing the consequences of accidental releases from valves which do occur.

The General Duty Clause aids EPA's goal of increasing chemical safety and preventing chemical accidents. Failure to comply with the General Duty Clause is a violation of the Clean Air Act.

EPA's Audit Policy and Small Business Policy

EPA has adopted two policies designed to encourage greater compliance with environmental laws and regula-

Side View of a Common Check Valve



Direction of flow →

tions, including the General Duty Clause. The "Incentives for Self-Policing, Discovery, Disclosure, Correction and Prevention of Violations" (Audit Policy) and the "Policy on Compliance Incentives

for Small Businesses" (Small Business Policy), provide incentives to conduct environmental audits by substantially reducing penalties for entities that voluntarily discover, disclose, and expeditiously correct violations of environmental law. More information about the Audit Policy and Small Business Policy can be obtained at <http://www.epa.gov/oeca/auditpol.html> and <http://www.epa.gov/oeca/smbusi.html>, respectively.

Contact Leslie Oif, RCRA Enforcement Division, Office of Regulatory Enforcement, at (202) 564-2291 or Email oif.leslie@epamail.epa.gov.

Useful Websites and Resources

RCRA Enforcement Division: <http://www.epa.gov/oeca/ore/red/>

Chemical Emergency Preparedness and Prevention Office:
<http://www.epa.gov/swercepp/>

Occupational Safety and Health Administration: <http://www.osha.gov>

EPA's Emergency Planning and Community Right-to-Know Hotline: (800) 424-8346 or (703) 412-9810. (TDD (800) 553-7672)

EPA's Year 2000 website: <http://www.epa.gov/year2000>

EPA's Y2K Enforcement Policy: <http://www.epa.gov/oeca/eptdd/ocy2k.html>
or contact Gary Jonesi, Office of Regulatory Enforcement
(202) 564-4002 or E-mail: jonesi.gary@epa.gov

Y2K Home Page: <http://www.y2k.com/>

EPA's Small Business Gateway: <http://www.epa.gov/smallbusiness>



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