6th INTERNATIONAL MULTIDISCIPLINARY CONFERENCE

THE RELATION BETWEEN QUALITY AND SAFETY OF INDUSTRIAL HYDRAULIC SYSTEMS.

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Abstract: *The hydraulic industrial systems are more and more widely utilized in the fields of industry, due to their obvious advantage. Their quality requirements and the need to fulfill hard safety criteria are subject of serious concerns in their success and competitiveness. Their safety is translated also in the safety of industrial systems in which they are implemented. (chemical, nuclear, energetic, mining etc). The paper deals with aspects related to the interdependence between the fulfillment of quality requirements and safety ones, taking into account the balance of decision between investing in quality and acceptation of a certain safety level.*

Key words: *fluid power systems, safety, risk assessment*

1. INTRODUCTION

The industrial hydraulic systems(known also as fluid power systems, FPS) are characterized by a high level of sophistication, technology intensive manufacturing, high level quality requirements, high qualification of operating manpower requirements, and as a consequence, high level of risk during operation, maintenance and breakdown produced consequences.

FPS are used in critical industries, such as mining, nuclear power, aircraft, chemical, a.s.o.

Starting from these elements, in the actual context, the safety and quality requirements emerged from their evolution trends are very important.

2.RELATION BETWEEN QUALITY, SAFETY AND DEVELOPMENT TRENDS

As Fig. 1 shows, hydraulics totally dominated certain types of equipment (e.g., machine tools and aircraft) early in their development but began to lose out partially to electrics during their maturing period, hi some equipment, hydraulics never achieved complete domination but shared with electrics from the very start. But what should be encouraging is that hydraulics has been able to maintain its domination in many equipment areas over the past 40 years.

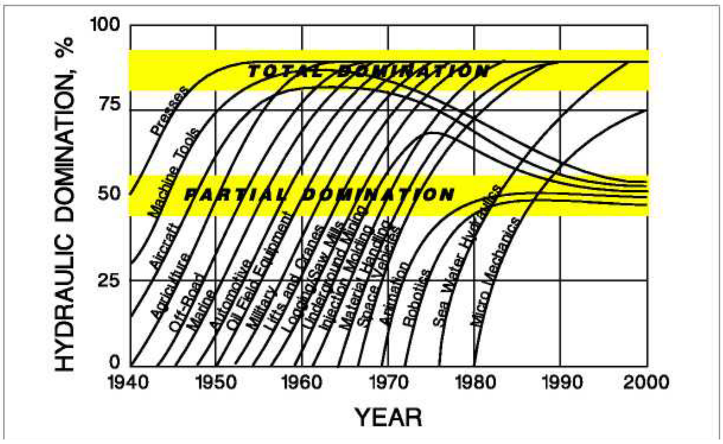

Fig.1 Fluid power equipment trends

Advancement in the area of the fluid power prime mover is very important and key factor for future application. The compactness of Pumps and Motors with very high capacity will be the demand for the future. Some of the aerospace technology has to be tailored to fit future Mobil and Industrial applications. Hydraulic Muscle with electronic brain is behind us. Technology needs to evolve into Macro Hydraulic muscle with micro electronic chips, to make machine and equipment faster and stronger. Future fluid power technology will see industrial machinery, more versatile and infinitely accurate and construction and earthmoving equipments supremely faster with high maneuverability.

The types of advances that can be expected over the next five years break down into two categories: **1.** Manufacturing Flow and Efficiency **2.** Optimized and Innovative Technology use.

Manufacturing-related advances involve the latest fabrication techniques and systems, together with innovative concepts such as one-piece flow, customer-focus process orientation, and a continued use of the “lean enterprises.” These all will provide minimal WIP, shorter cycle times, and reduced costs. The technological impact over the next five years will include some fluid power advances as well as the growth of substitute products. We can expect more networked devices and imbedded intelligence in fluid power products as well as PC-based controls and a growing use of wireless.

The combined use of both hydraulics and electrics to form hybrid devices will expand over the coming years, where only fluid power had existed in the past. More pure electrics will advance to a larger market share as the technology matures, providing a significant risk to the Fluid Power Industry in the future

Safety Safety is the portion of a loss prevention program involved in reducing the chance of injury to not only machine operators but all persons, including maintenance (highest injury rate in the past), as well as damage to the machine, damage to other company assets, and harm to the environment. Standards now acknowledge that there is no such thing as zero risk.

The important thing in control integrity is that the integrity of the entire system must be considered, not just the electrical control portion. The entire system is rated based on the weakest link in the system chain. The function of a control valve is equivalent to the function of an electrical control relay, and, therefore, is subject to the same rules for selection of safety integrity category. This means that a safety relay is equivalent to a control reliable-valve. To be control-reliable, a valve or system must be:

- Redundant in function,
- Monitored for a fault and, therefore, the loss of redundancy,
- Of fail-to-safe design (single failure does not inhibit the safety stopping function),
- Able to lock-out and inhibit further operation upon detection of a fault until corrected, and
- Be designed and manufactured, with safety in mind, specifically for critical applications.

Fluid power is similar to, but also different from, electrical controls. Attaining just plain old redundancy in a safety circuit requires the function of four valves, not just two. Two valves are required for the inlet function and two for the stop function (release of the energy). Many self-designed systems have hidden, potential flaws, which can lead to unsafe conditions since they are unseen, unexpected, and, therefore, excluded from design and safety reviews. A good example is the spool cross-over conditions or ghost positions of a valve, which are usually not shown on schematics.

Risk assessment can be used to determine what minimum level of safety products must be used for a specific application, and weighs the degree of harm (injury, damage to property, or harm to the environment) that may result from an accident and then prompts steps to be taken to determine if it is feasible to reduce these risks to a tolerable level. Risk assessment incorporates additional parameters such as the probability of such an accident occurring, the severity of the harm, the amount of exposure workers have, and the possible ways the worker has to avoid the risk. The risk assessment process also allows for the fact that not all risks can be eliminated or reduced within reasonable economic limits. In addition, risk assessment is a task based program and recognizes that some risks must be present to perform certain tasks.

Risk in PFS are associated with pressure and temperature . The trends in pressure levels used in fluid power systems are shown graphically in Fig. 2.a. As new materials, better designs, and more effective contamination control become a reality, the pressure levels will climb.

The temperature trends are shown in Fig. 2.b. Sealing materials and fluids are the primary limitations in temperature levels. Safety is also becoming a major consideration. System designs are moving toward operator protection from such high temperature systems.

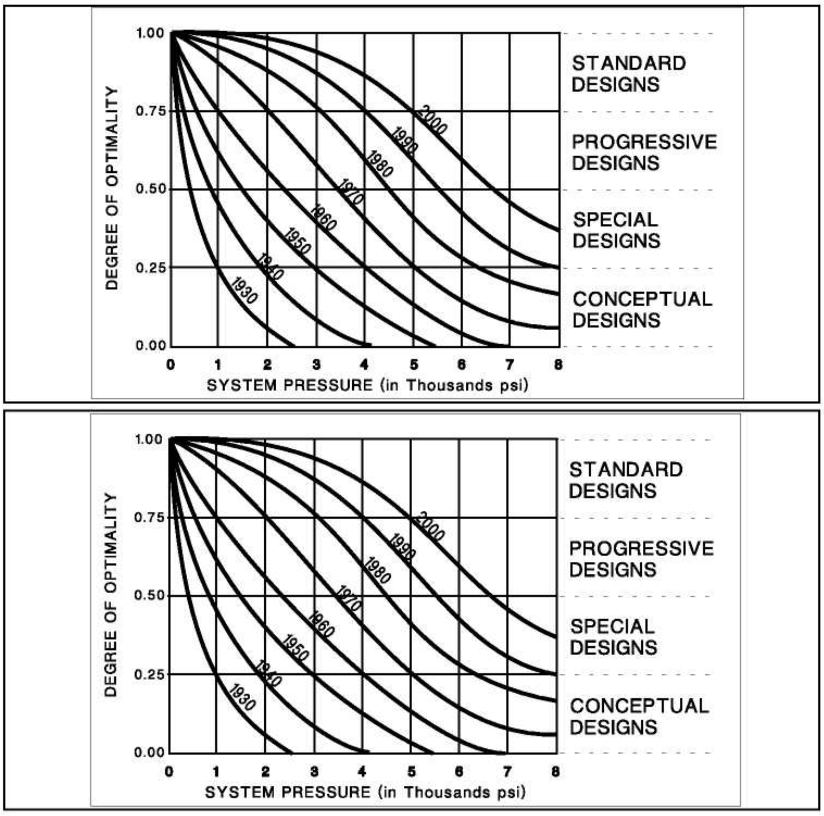

Fig. 2. Pressure (a) and temperature (b) trends in FPS