DIERS

IMPLEMENTATION

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DIERS IMPLEMENTATION

ABSTRACT

The technology developed by The Design Institute for Emergency Relief Systems (DIERS) has been documented and published and continues to be the subject of interpretation. Application of this technology to new pressure relief system designs is fairly straightforward. Application to existing pressure relief systems presents many challenges including management commitment, funding, and training.

This paper outlines how one of our larger sites has initiated overall implementation of DIERS technology. Also included are some typical personnel requirements, general computer resource utilization, and a priorization model.

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DIERS IMPLEMENTATION

The purpose of this paper is to discuss implementation of DIERS technology, both in existing operations and proposed new operations.

Dow started to implement DIERS technology in 1984 with the formation of a Pressure Relief Emphasis Team which goes by its natural acronym of PRET.

The team was given a charter to identify, develop, communicate, and implement technology and tools to enable qualified engineers from our organization to efficiently design appropriate relief systems for emergency pressure relief. We have recently reviewed that charter or mission statement and find it still valid.

One of the first things we did was to find out where we were, where we needed to go, or where we were headed. We put together a package of round-robin or design problems. The problem sets included a flow diagram and equipment sketch along with a "textbook" description of problem statements. The description included vessel size, maximum allowable working pressure, normal temperatures, vessel contents, etc. The credible or relief scenario was also given. Runaway reactions were specifically excluded.

We sent them to six major areas and asked that experienced people size the appropriate reliefs for the example problems. They were to use any applicable location or site-specific criteria. We got a range of answers back that really surprised us. For example, the calculated sizes ranged from as much as a 3K4 to a 6Q8 for the <u>same</u> problem. The answers for another problem ranged from as much as 3K4 to 3 - 8T10 or one 12W16. We also noted considerable variation in maximum allowable piping lengths. In addition, we found that checking for two-phase flow possibilities was not uniform. We found that credits for insulation varied from location to location. There were some questionable evaluations of physical properties for mixtures, and in some cases, rules of thumb caused a variation in some of the sizes. There were no right or wrong answers to these problems and the conclusions above are the reasons for the noted variations.

At the same time that all of the above was being evaluated, the DIERS technology was really starting to emerge, be summarized, and made available to the general public. This includes the two-phase work that was done by Fauske and Associates. In addition, SAFIRE and FAI's VSP were commercially available.

In our presentation to management, the team included a simple schematic of what this VSP analytical device looks like, and brief details on how it works. We made our management aware of the advantages of the VSP over the ARC: that it is quicker, cheaper, and more accurate than the ARC for most of our needs; It does not require detail knowledge of the specific chemistry added to kinetics and the thermodynamics of your problem; It can be used to design early intervention systems to prevent run-away reactions or

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gather base-case data. Also, the base-case data can be used to design a new relief system or rate an existing relief system. When one wants to make a slight catalyst change, change the order of addition, or change the overall recipe, the effects of the proposed change on relief system requirements can be determined by comparing the two cases.

The team made the following recommendations to our management for implementation:

1. Adopt A "Reviewer System" (defined later)
2. Train The Necessary People
3. Use The New Techniques On All New Projects
4. Develop Plans For Evaluating Existing Facilities

We got started real fast in the training effort and put together what we called a "Global Train-the-Trainer" session to which we invited two representatives from all our locations, including the overseas locations, to send appropriate personnel to our Corporate headquarters to participate in a training session on all this new technology. We had a very good response and the participating locations and number of representatives are shown in the attached appendix.

We have taken a look at our operations in Texas to see how many existing systems need review. We have registered in our operations in Freeport, 12500 relief systems. We have an adjacent operating site at Oyster Creek that has 750, and with a recent acquisition added another 1300 systems to our overall count. If we allow for dual installations and in some cases, duplicate installations, we expect that the 14500 will be reduced to about 9000.

We have put together a list of workhour activities shown in the appendix. The first thing to do is list the device and assign a priority. We envision about 15 minutes with our prioritization program. Data collection and isometric sketches will require about 4 hours and is applicable to all systems.

Then we have three categories of calculations; BASIC, COMPLEX, and REACTIVE.

1. BASIC calculations are taken to mean single phase, and only one component.
2. COMPLEX calculations cover everything else except reactive.
3. REACTIVE, of course, speak for themselves.

We have data that indicates about 50% of the valves fall in the Basic category, approximately 35% in the Complex category, and the remaining 15% in the Reactive category. The historic hours required to calculate each type are:

Basic	3 hrs
Complex	12 hrs
Reactive	30 hrs

If the 9000 count and/or the 50:35:15 split is not applicable to your operation, some other combinations are shown in the appendix. The high percentage of reactives does not mean a large number of reactions for each plant. It indicates that there are many systems handling the same reactive materials. It is important to note that our estimates do not include any of the analytical time that is required to run any ARC or VSP experiments.

To accomplish this overall we have established a project team. We found, as a result of some recent acquisitions, that it works better to send a project team in to get all those things done that we consider top priority rather than issue general guidelines and letting plants come up with their own plans for the compliance.

We have included the following functions on our project team:

Project Manager

Chemical Engineers to calculate

Reviewers

Analytical Coordinators (reactive data acquisition)

Field Technicians (data collection and isometric sketches)

Clerical Support

The charter to that group was first of all to define the overall magnitude of the project and to then start working on the highest priority areas. We also included a little logic diagram (attached) of how things might go through the process starting with the plants doing the listing, prioritizing, gathering the data, and ending with recommendations for any systems that require changes. It is also important to note that our cost estimates do not include any actual hardware changes or revisions.

REVIEWER CONCEPT - First, we eliminated the "certified designer list" (a list of around 250 to 350 "certified designers"). Certified designers were those who completed an open book test (about nine problems) and submitted their test to the system administrator. If everything looked fine, then they would have their first one or two designs reviewed by a knowledgeable person and if everything was in order, certified status was achieved.

The reviewer concept requires that all designs be reviewed by an approved reviewer. We have two levels of reviewers: Reviewers who can review and sign for basic and complex designs and Senior Reviewers who can do the same for any level of design. The reviewers will be kept abreast of the latest technology. The reviewers' function is to review the design basis and assumptions, not arithmetic.

The organizational structure has been assembled and is called our Relief Systems Technology Group. The structure is attached. This group has also taken on all of the related training effort.

Before that team really got started, they looked at what some of their plans and needs were:

1. A Mission Statement to guide their efforts
2. Identify and Scope the required computer tools
3. Develop a Prioritization System
    A. Team does high priority systems
    B. Production folks do the lower priority systems
4. Develop an electronic registration system

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5. Develop an integrated calculation and documentation system
   A. Scenario Selection (DIERS WCCQ and an "Expert System")
   B. Calculations (SAFIRE or in-house programs)
   C. Specific Audit Checklist for each system

The Audit Checklist would be a customized checklist for that particular relief system alone. It would have key questions on it, key statements indicating what things went in to establishing a credible scenario, what instrumentation credits were taken to help reduce the size of the relief device, other things such as credit for insulation - things that which can be changed throughout the life of the system and perhaps not be picked up in any other fashion.

6. Training Effort
7. Plans for new versus existing systems.

The Mission Statement of the Relief Systems Technology Group and attributes of the perfect tool are also shown in the appendix.

To find out which systems needed to be worked on first, we put together a little prioritization model (attached). First of all, we worked at prioritizing by categories - those that were reactive and/or highly viscous (highly viscous in our operation is something greater than 500 centipoise) known foamers, those systems that have high operating levels in their vessels, systems that have obvious piping restrictions, or systems assumed adequate. Within those categories we

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prioritize considering flammability, toxicity, and volume. Guidelines were given as to what is meant by non, moderate, high, small, medium, and large. For example, small is less that 50 gallons.

Implementation on new capital projects started as soon as a core group of personnel were trained. With existing systems, the prioritization model identifies where to start calculating and documenting.

In summary, it is important to structure the system so that the procedures and the system remain after the project team is gone. The system which has been put together should not operate in an atmosphere wherein no one knows how to do any of the calculations by hand.

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PRESSURE RELIEF EMPHASIS TEAM

(ESTABLISHED IN 1984)

JOHN MONROE	LOUISIANA
GENE DEHAVEN	WESTERN
JIM HUFF (RET.)	MICHIGAN
DAVE WINEGARDNER	MICHIGAN
PAT SIMISKEY	TEXAS
VAL JANECEK	TEXAS
LARRY LAFITTE	LOUSIANA
HUGH VEACH	SARNIA
KEY CONTACTS	8 REMOTE LOCATIONS
ROY VINING (PAST CHAIRMAN)	TEXAS

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CHARTER

IDENTIFY, DEVELOP, COMMUNICATE AND IMPLEMENT TECHNOLOGY AND TOOLS TO ENABLE QUALIFIED ENGINEERS WITHIN DOW TO EFFICIENTLY DESIGN APPROPRIATE RELIEF SYSTEMS FOR EMERGENCY PRESSURE RELIEF.

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ROUND ROBIN PROBLEMS

6 NORTH AMERICAN SITES

9 STANDARD RELIEF PROBLEMS

A. RELIEF SCENARIO GIVEN

B. "TEXT BOOK" PROBLEM DESCRIPTION

C. USE LOCATION SPECIFIC CRITERIA

D. ALL NON-REACTIVE

EXAMPLE RESULTS OR ANSWERS

A. RANGE FROM 3K4 TO 6Q8 FOR ONE PROBLEM SET

B. RANGE FROM 3K4 TO 3 EA 8T10 OR 12W16 FOR ANOTHER SET

C. RANGE OF 100 TO 185 FEET OF ALLOWABLE DISCHARGE PIPING

OTHER FINDINGS OR CONCLUSIONS INCLUDE:

CONCLUSIONS FROM ROUND-ROBIN

1. TWO-PHASE FLOW CONSIDERATIONS NOT UNIFORM.

2. VARYING FLOW EQUATIONS WERE USED.

3. CREDITS FOR INSULATION AND VESSEL SHAPES NOT UNIFORMLY APPLIED.

4. QUESTIONABLE EVALUATION OF PHYSICAL PROPERTIES FOR MIXTURES.

5. USE OF "RULES OF THUMB" CAUSED VARIATIONS.

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DIERS TECHNOLOGY

TWO-PHASE FLOW

BASED ON FAI EXPERIMENTATION.

JIM HUFF (MICHIGAN) WAS A PRIMARY SOURCE OF DIERS EXPERTISE.

COMPUTER PROGRAMS

SAFIRE.

REACTIVE SYSTEMS

VENT SIZING PACKAGE (FAUSKE/FIKE).

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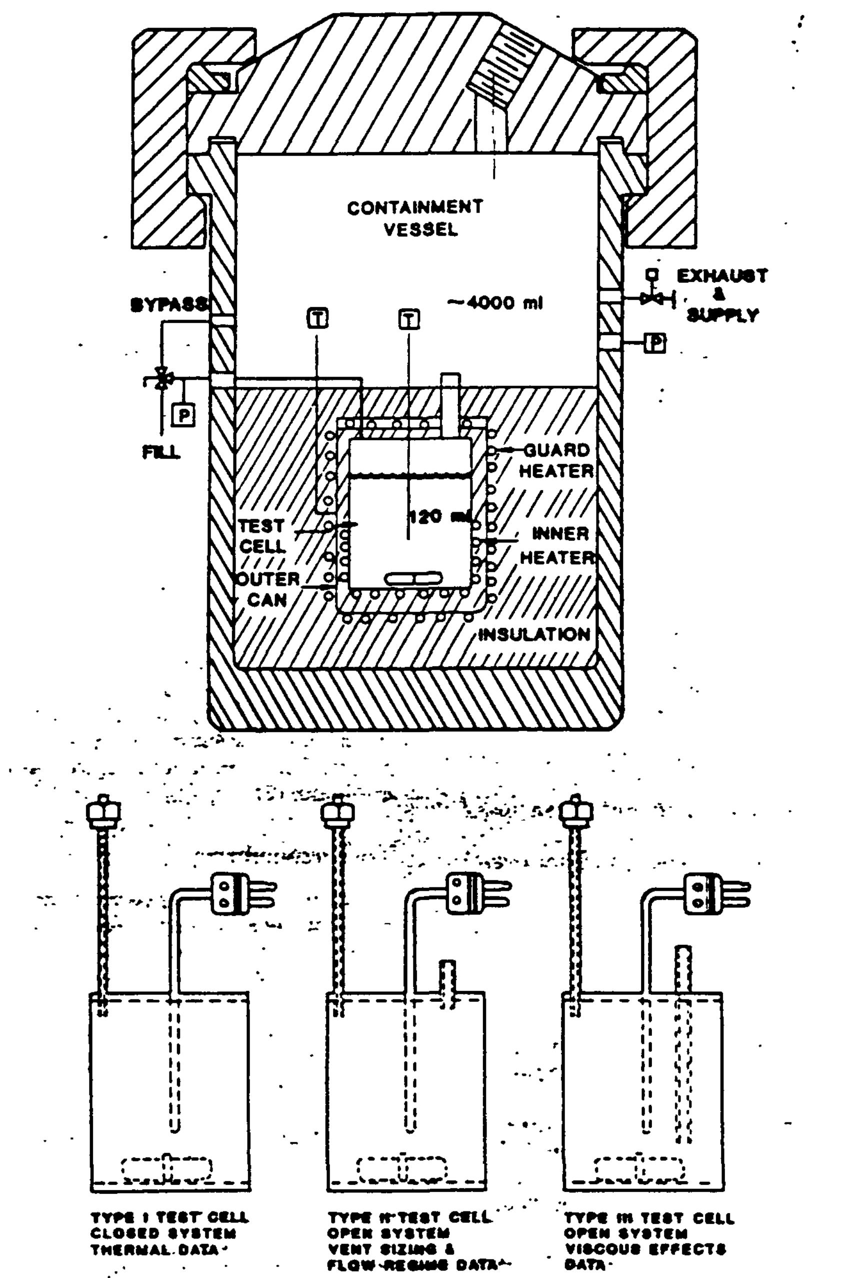
Figure 1. Small-scale test equipment with closed and open test cell designs.



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ADVANTAGES OF VSP

- QUICKER, CHEAPER, MORE ACCURATE THAN ARC (ACCELERATING RATE CALORIMETER)

- DOES NOT REQUIRE DETAILED KNOWLEDGE OF CHEMISTRY, KINETICS, THERMODYNAMICS, ETC.

- CAN BE USED TO DESIGN EARLY INTER-VENTION SYSTEMS TO PREVENT RUNAWAY CHEMICAL REACTIONS.

- AFFORDABLE FOR EVALUATING RESEARCH CHANGES SUCH AS NEW CATALYST, NEW BLENDS, ETC.

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SUGGESTIONS FOR IMPLEMENTATION

- ADOPT "REVIEWER" SYSTEM.

- TRAIN NECESSARY PEOPLE.

  USE NEW DESIGN TECHNIQUES ON ALL NEW PROJECTS.

- DEVELOP PLANS FOR EVALUATING EXISTING FACILITIES.

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GLOBAL TRAIN-THE-TRAINERS SESSION

LOCATION	REPRESENTATIVES
GERMANY (STADE)	1
US (2-TEXAS & 1-EASTERN)	3
CANADA (2-SARNIA & 1-FT SASK)	3
HOLLAND (TERNEUZEN)	2
BRAZIL (GUARUJA & ARATU)	2

PACIFIC AREA TRAINING

NEW ZEALAND	9 STUDENTS
AUSTRALIA	9 STUDENTS
HONG KONG & SURROUNDINGS	9 STUDENTS

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TEXAS OPERATIONS
SAFETY VALVE REVIEW

NUMBER OF VALVES TO CONSIDER:

REGISTERED IN TEXAS OPERATIONS	12,500
REGISTERED AT OYSTER CREEK	750
REGISTERED AT LAPORTE	1,300
TOTAL	14,550

ALLOWING FOR DUAL AND DUPLICATE INSTALLATIONS, WE EXPECT TO REVIEW ABOUT 9,000 SYSTEMS.

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WORK-HOUR REQUIREMENTS

ACTIVITY	APPLICABLE TO	HRS/ACT	HOURS
LIST/PRIORITIZE	9000	0.25	2,250
DATA/ISOS	9000	4	36,000
BASIC CALCS	9000 (.5)*	3	13,500
COMPLEX CALCS	9000 (.35)*	12	37,800
REACTIVE CALCS	9000 (.15)*	30	40,500
		TOTAL HOURS =	130,050

*BASED ON ONE DIVISION'S EXPERIENCE

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WORK-YRS/M$ REQUIRED TO DO CALCULATIONS

NO. OF PSV'S	% SPLIT - BASIC/COMPLEX/ REACTIVE	
	50/35/15	70/20/10
9000	68/$5.2	55/$4.2
7000	53/$4.1	43/$3.3
5000	38/$2.9	30/$2.3
3000	23/$1.8	18/$1.4
1000	8/$0.6	6/$0.5

DOES NOT INCLUDE ARC/VSP TIME OR COSTS

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PROJECT TEAM APPROACH

CONSIDER ESTABLISHING A PROJECT TEAM WITH THE FOLLOWING TYPES OF FUNCTIONS INCLUDED:

PROJECT MANAGER
CHEMICAL ENGINEERS
PRESSURE RELIEF DESIGN REVIEWERS
ANALYTICAL COORDINATORS
FIELD TECHNICIANS
CLERICAL

PROJECT TEAM CHARTER

- o DEFINE OVERALL MAGNITUDE OF PROJECT
- o START WORKING ON HIGHEST PRIORITY AREAS

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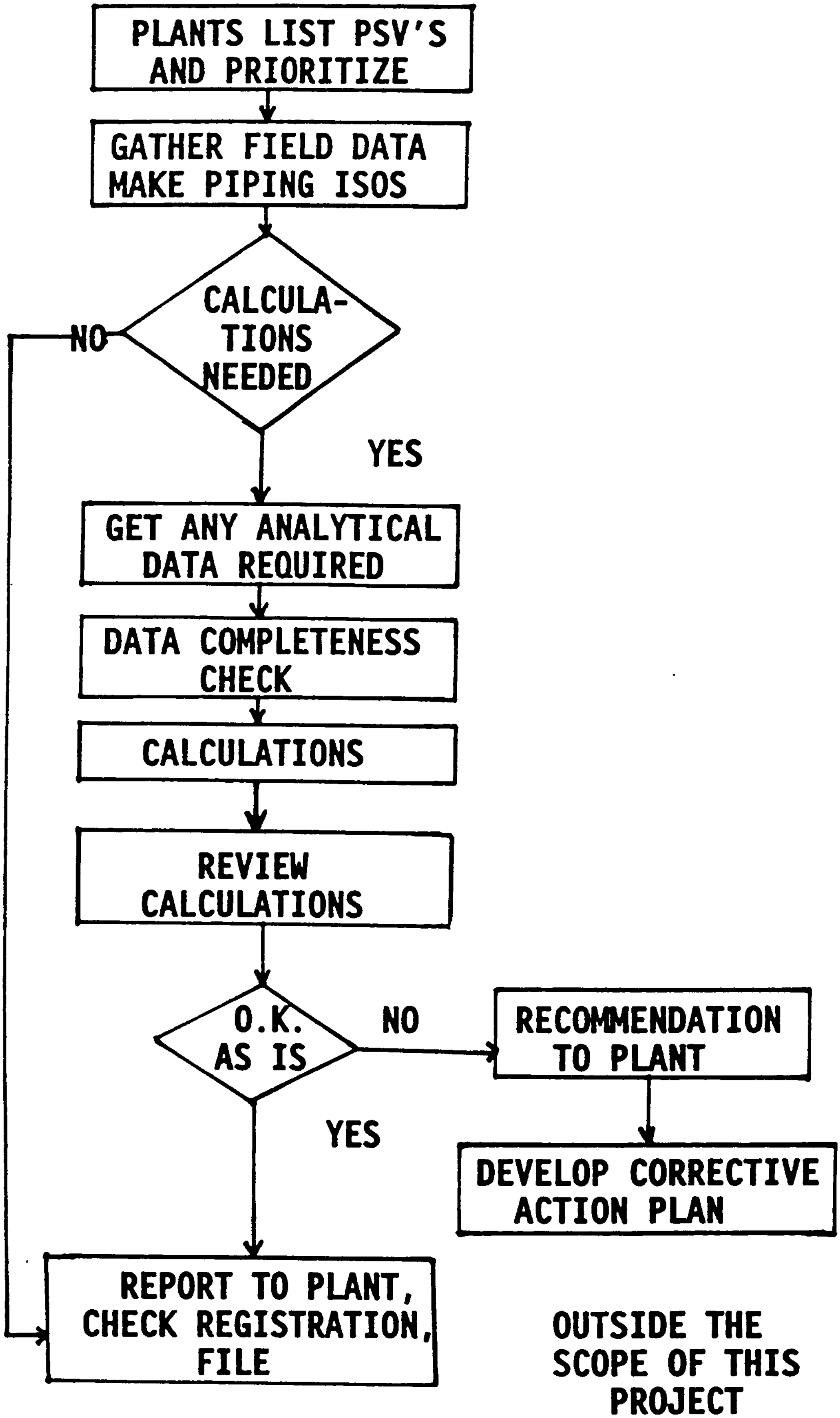
PLANTS LIST PSV'S AND PRIORITIZE
GATHER FIELD DATA MAKE PIPING ISOS
CALCULA- TIONS NEEDED
NO
YES
GET ANY ANALYTICAL DATA REQUIRED
DATA COMPLETENESS CHECK
CALCULATIONS
REVIEW CALCULATIONS
O.K. AS IS
NO
RECOMMENDATION TO PLANT
DEVELOP CORRECTIVE ACTION PLAN
YES
REPORT TO PLANT, CHECK REGISTRATION, FILE
OUTSIDE THE SCOPE OF THIS PROJECT

REVIEWER CONCEPT

- ELIMATE "CERTIFIED DESIGNER LIST"
- ANYONE CALCULATE
- 3 LEVELS OF REVIEWERS

  BASIC (30-50)

  COMPLEX (12-15)

  REACTIVE (6-8)

- CHECK BASES -- NOT ARITHMETIC

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PROJECT MANAGER

PROJECT CLERK

TRAINING AND REVIEW	ANALYTICAL COORDINATOR	CHEMICAL ENGINEERS	RESEARCH ENGINEERS
TRAINING REVIEW	GET NECESSARY ANALYTICAL WORK DONE	DO REACTIVE & COMPLEX CALCUL. REVIEW. (FOR PRODUCTION AREA)	DO REACTIVE & COMPLEX DOCUMENT. (FOR RESEARCH AREA)

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TEAM PLANS/NEEDS

1. MISSION STATEMENT

2. IDENTIFY AND SCOPE REQUIRED COMPUTER TOOLS

3. DEVELOP A PRIORITIZATION SYSTEM

   A. TEAM DOES HIGH PRIORITY SYSTEMS

   B. PLANT/PRODUCTION DOES LOW PRIORITY SYSTEMS

4. DEVELOP ELECTRONIC REGISTRATION SYSTEM

5. DEVELOP INTEGRATED CALCULATION AND DOCUMENTATION SYSTEM

   A. START IS SCENARIO SELECTION VIA ES/AI

   B. CALCULATIONS

   C. FINISH IS AUDIT CHECKLIST

6. TRAINING EFFORT

7. NEW VS EXISTING INSTALLATIONS

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THE MISSION OF THE RELIEF SYSTEMS TECHNOLOGY GROUP IS:

1. TO AUTOMATE AND REFINE THE RELIEF SYSTEMS CALCULATION AND DOCUMENTATION TOOLS.

2. TO TRAIN OTHERS IN RELIEF SYSTEMS TECHNOLOGY.

3. TO CALCULATE AND DOCUMENT RELIEF SYSTEMS.

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PERFECT TOOL

- MAIN FRAME BASED/PC INTERACTIVE
- FORCED LOGIC TREE
- SIZES AND RATES SYSTEM
- INTERFACES PHYS PROP FILES
- SELF TRAINING
- ISOMETRICS ON COMPUTER
- UNIFORM DOCUMENTATION
- CUSTOMIZED CHECKLIST
- ELECTRONIC REGISTRATION

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A PRIORITIZATION MODEL

- PRIORITIZE BY CATEGORY
  - REACTIVE
  - VISCOSITY >500 CP
  - FOAMY
  - OPERATING LEVEL
  - PIPING RESTRICTIONS
  - ASSUMED ADEQUATE

- PRIORITIZE WITHIN CATEGORIES

F - FLAMMABILITY	(NON, MOD, HIGH)
T - TOXICITY	(NON, MOD, HIGH)
V - VOLUME	(SMALL, MED, LARGE)

PRIORITY INDEX = $(F + T) \times (V + 1)$

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IMPLEMENTATION

1. NEW CAPITAL PROJECTS
   - TRAINING
   - GO
2. EXISTING SYSTEMS
   - ESTABLISH PROJECT TEAM
   - SURVEY
   - PRIORITIZE
   - CALCULATE
   - DOCUMENT

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SUMMARY

OBJECTIVE

STRUCTURE SUCH THAT THE SYSTEM AND PROCEDURES REMAIN AFTER THE TEAM DISSOLVES.

"DANGER"

NO ONE KNOWS HOW TO CALCULATE AFTER THE TEAM LEAVES.

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