IN THE MATTER OF

THE B.F. GOODRICH COMPANY, ET AL.

FINAL ORDER, OPINION, ETC., IN REGARD TO ALLEGED VIOLATION OF SEC. 7 OF THE CLAYTON ACT AND SEC. 5 OF THE FEDERAL TRADE COMMISSION ACT

Docket 9159. Complaint, Jan. 4, 1982—Final Order, Mar. 15, 1988

This final order requires Goodrich, a corporation with its principal place of business in Akron, Ohio, to divest the vinyl cloride monomer (VCM) plant, in La Porte, Texas, at no minimum price, to a Commission-approved acquirer and also to provide all supporting material to the acquirer. Diamond Shamrock Chemicals Company is prohibited from interfering with the divestiture and, for five years, must continue to supply all utilities, services, and supplies to the acquirer. In addition, Goodrich must, for 10 years, receive FTC approval before acquiring any interest in any producer of VCM located in the United States. The Commission also dismissed part of the complaint concerning the polyvinyl chloride (PVC) market.

Appearances

For the Commission: *Rhett Krulla.*

For the respondents: *Tom D. Smith, Jones, Day, Reavis & Pogue,* Washington, D.C.

COMPLAINT

The Federal Trade Commission, having reason to believe that respondents, The B.F. Goodrich Company, Diamond Shamrock Corporation and Diamond Shamrock Plastics Corporation, corporations subject to the jurisdiction of the Federal Trade Commission, have entered into an agreement, described in paragraph 11 herein, that, if consummated, would violate the provisions of Section 7 of the Clayton Act, as amended (15 U.S.C. 18), and Section 5 of the Federal Trade Commission Act, as amended (15 U.S.C. 45); that said agreement and the actions of respondents to implement that agreement constitute violations of Section 5 of the Federal Trade Commission Act, as amended (15 U.S.C. 45); and it appearing to the Commission that a proceeding in respect thereof would be in the public interest, the Commission hereby issues its complaint, pursuant to Section 11 of the Clayton Act (15 U.S.C. 21) and Section 5(b) of the Federal Trade Commission Act (15 U.S.C. 45(b)), stating its charges as follows:

I. DEFINITIONS

1. For purposes of this complaint, the following definitions shall apply: [2]

a. *"Polyvinyl chloride"* or *"PVC"* means any vinyl chloride homopolymer with the repeating unit $CH_2{=}CHC1$, and any copolymers of vinyl chloride with varying amounts of other chemicals, including vinyl acetate, ethylene, propylene, vinylidene chloride, or acrylates;

b. *"Bulk and suspension PVC"* includes PVC produced by the bulk or mass process, in which vinyl chloride is polymerized without the addition of other liquids; and PVC produced by the suspension process, in which vinyl chloride monomer droplets are suspended in an aqueous system.

c. *"Dispersion PVC"* includes PVC produced by the emulsion or dispersion process;

d. *"Vinyl chloride monomer"* or *"VCM"*, is a gaseous, reactive, acyclic intermediate chemical, used principally in the manufacture of PVC. VCM, also called chloroethylene or monochloroethylene, has a chemical identity $CH_2{=}CHC1$.

II. THE B.F. GOODRICH COMPANY

2. Respondent, The B.F. Goodrich Company ("Goodrich"), is, and at all times relevant herein, has been a corporation organized, existing, and doing business under and by virtue of the laws of New York, with its principal place of business in Akron, Ohio.

3. For the year ending December 31, 1980, Goodrich's net sales were approximately $3.08 billion, and its net income was approximately $61.7 million. As of December 31, 1981, Goodrich's bulk and suspension PVC and VCM production capacities were approximately 1.345 billion pounds and 1 billion pounds per year, respectively.

4. Goodrich is a multinational company engaged in the manufacture and sale of a broad line of chemical, plastic, rubber, and other products which are distributed in over [3] 100 countries throughout the world.

5. Goodrich is, and at all times relevant herein has been, engaged in commerce as "commerce" is defined in Section 1 of the Clayton Act, as amended, 15 U.S.C. 12, and is a corporation whose business is in or affecting commerce as "commerce" is defined in Section 4 of the Federal Trade Commission Act, as amended, 15 U.S.C. 44.

III. DIAMOND SHAMROCK CORPORATION

6. Respondent, Diamond Shamrock Corporation ("Diamond Shamrock") is, and at all times relevant herein has been, a corporation organized, existing, and doing business under and by virtue of the

laws of Delaware, with its principal office and headquarters in Dallas, Texas.

7. For the calendar year ending December 31, 1980, Diamond Shamrock's sales and operating revenues were approximately $3.143 billion, and its net income was approximately $201 million. As of December 31, 1981, Diamond Shamrock's bulk and suspension PVC and VCM production capacities were approximately 510 million pounds and 1 billion pounds per year, respectively.

8. Diamond Shamrock is a diversified international corporation involved in the exploration and production of natural gas and crude oil, the refining and marketing of petroleum products, and the production of coal, chemicals, plastics, and technology.

9. Diamond Shamrock is, and at all times relevant herein has been, engaged in commerce as "commerce" is defined in Section 1 of the Clayton Act, as amended, 15 U.S.C. 12, and is a corporation whose business is in or affecting commerce as "commerce" is defined in Section 4 of the Federal Trade Commission Act, as amended, 15 U.S.C. 44. [4]

IV. DIAMOND SHAMROCK PLASTICS CORPORATION

10. Diamond Shamrock Plastics Corporation ("DSPC") was established by Diamond Shamrock in 1980 in order to facilitate divestiture of Diamond Shamrock's Plastics Division. Upon establishment of DSPC as a wholly-owned subsidiary, Diamond Shamrock transferred all of its PVC and VCM assets and business to DSPC and has continued to conduct these businesses through DSPC. Diamond has subsequently restructured DSPC to include only those assets it has agreed to transfer to Goodrich. Diamond Shamrock will establish a new corporation to hold the remaining PVC assets and business of the company pending their disposition by Diamond Shamrock.

V. THE ACQUISITION

11. Under the terms of the agreement between Goodrich and Diamond Shamrock, on or about December 31, 1981, Goodrich will acquire from Diamond Shamrock all the stock of DSPC for $131 million. Pursuant to Diamond Shamrock's agreement with Goodrich, prior to its acquisition by Goodrich, DSPC has been restructured to include a one-billion pound-per-year capacity VCM plant at La Porte Texas, and a 280 million pound-per-year capacity suspension PVC plant (plant No. 5) at Deer Park, Texas, selected research and development equipment, process and application equipment, and personnel and other assets required to operate those plants. Consummation of the transaction is subject to the execution of agreements between Goodrich and Diamond Shamrock concerning feedstock supplies.

VI. TRADE AND COMMERCE

12. For purposes of this complaint, the relevant lines of commerce are VCM, bulk and suspension PVC, dispersion PVC and any submarket thereof. [5]

13. For purposes of this complaint, the relevant geographic market is the United States as a whole, and any submarket thereof.

14. In 1980, approximately 6.47 billion pounds of VCM were produced in the United States. The VCM market is concentrated. In 1981, the two leading manufacturers accounted for approximately 37.9 percent of industry nameplate (design) capacity, the four leading manufacturers accounted for 58.4 percent; and the eight leading manufacturers accounted for 92.1 percent.

15. Goodrich and Diamond Shamrock are tied as the third leading manufacturer of VCM, each holding 10.3 percent of industry nameplate capacity in 1981.

16. Goodrich and Diamond Shamrock are direct, substantial, and actual horizontal competitors in the VCM market.

17. Barriers to entry into the VCM market are significant and substantial.

18. In 1980, approximately 4.88 billion pounds of bulk and suspension PVC were produced in the United States.

19. The bulk and suspension PVC market is moderately concentrated. In 1981, the two leading manufacturers accounted for approximately 29.3 percent of industry nameplate capacity, the four leading manufacturers accounted for 48.0 percent, and the eight leading manufacturers accounted for 78.9 percent.

20. Goodrich is the leading producer of bulk and suspension PVC, with approximately 17.4 percent of industry nameplate capacity in 1981.

21. Goodrich has grown through acquisition in the bulk and suspension PVC market. In 1979, Goodrich acquired a 200 million pound-per-year bulk and suspension PVC plant in Plaquemine, Louisiana, from The Goodyear Tire and Rubber Company. At [6] the time of this acquisition, Goodrich held 15.5 percent of industry capacity. The acquired plant gave Goodrich an additional 3.1 percent of industry capacity.

22. Diamond Shamrock is the sixth leading producer of bulk and suspension PVC with approximately 6.6 percent of industry nameplate capacity and 8.9 percent of practical production capacity in the market in 1981. Pursuant to the transaction, approximately half of Diamond Shamrock's production capacity will be transferred to Goodrich, raising its market share to approximately 20.8 percent of industry nameplate capacity.

23. Goodrich and Diamond Shamrock are direct, substantial, actual, horizontal competitors in the bulk and suspension PVC market.

24. Barriers to entry into the bulk and suspension PVC market are significant.

25. In 1979, approximately 496 million pounds of dispersion PVC were produced in the United States.

26. The dispersion PVC market is highly concentrated. In 1980, the two leading manufacturers accounted for approximately 51.7 percent of industry nameplate capacity, the four leading manufacturers accounted for 78.3 percent, and the eight leading manufacturers accounted for 100 percent.

27. Goodrich is the leading producer of dispersion PVC with approximately 26.6 percent of industry nameplate capacity in 1980.

28. Diamond Shamrock is the fourth leading producer of dispersion PVC with approximately 11.8 percent of industry nameplate capacity in the market in 1980. Following the transaction with Goodrich, Diamond Shamrock is likely to shut down or sell its dispersion PVC plant facilities. These facilities are not currently included in the Goodrich acquisition. [7]

29. Goodrich and Diamond Shamrock are direct, substantial, actual, horizontal competitors in the dispersion PVC market.

30. Barriers to entry into the dispersion PVC market are significant.

VII. EFFECTS OF THE ACQUISITION

31. The effect of the aforesaid acquisition may be substantially to lessen competition or to tend to create a monopoly in the relevant lines of commerce in violation of Section 7 of the Clayton Act, as amended, 15 U.S.C. 18, and Section 5 of the Federal Trade Commission Act, as amended, 15 U.S.C. 45, in the following ways, among others:

a. It will eliminate actual competition between Goodrich and Diamond Shamrock in the relevant lines of commerce;

b. It will increase concentration in the relevant lines of commerce and reduce the number of firms competing in those markets. In the VCM market, two-firm concentration will increase from approximately 37.9 percent to 42.6 percent and four-firm concentration will increase from approximately 58.4 percent to 68.7 percent. In the bulk and suspension PVC market, two-firm concentration will increase from approximately 29.3 percent to 32.9 percent and four-firm concentration will rise from approximately 48.0 percent to 51.7 percent.

32. Diamond Shamrock may also be eliminated as a competitor in the production and distribution of dispersion PVC which is a separate

line of commerce from bulk and suspension PVC as defined above. Although Diamond Shamrock's dispersion PVC capacity will not be transferred to Goodrich under the terms of the agreement described in paragraph 11 herein, by virtue of that agreement, Diamond Shamrock may exit this [8] market as a substantial competitor.

VIII. VIOLATIONS CHARGED

33. The steps taken to consummate the acquisition of the stock and assets of DSPC by Goodrich from Diamond Shamrock, as set forth in paragraph 11 herein, and the agreements pursuant to which that acquisition is to be effected, constitute violations of Section 5 of the Federal Trade Commission Act, as amended, 15 U.S.C. 45.

34. The proposed acquisition of the stock and assets of DSPC by Goodrich from Diamond Shamrock, as set forth in paragraph 11 herein, if consummated, would violate Section 7 of the Clayton Act, as amended, 15 U.S.C. 18, and would violate Section 5 of the Federal Trade Commission Act, as amended, 15 U.S.C. 45.

INITIAL DECISION BY

THOMAS F. HOWDER, ADMINISTRATIVE LAW JUDGE

SEPTEMBER 20, 1985

PRELIMINARY STATEMENT

The Commission issued its complaint in this proceeding on January 4, 1982, charging that the acquisition of Diamond Shamrock Plastics Corporation ("DSPC") by The B.F. Goodrich Company ("Goodrich") from Diamond Shamrock Chemicals Company ("Diamond Shamrock" or "Diamond") (formerly Diamond Shamrock Corporation) violated Section 7 of the Clayton Act, 15 U.S.C. 18; and that both the acquisition and the concomitant agreement and steps taken to consummate the transaction violated Section 5 of the Federal Trade Commission Act, 15 U.S.C. 45.

The complaint alleged that the effect of the challenged acquisition would be to eliminate actual competition between Goodrich and Diamond and increase the levels of concentration in two product markets, *viz.*, bulk and suspension polyvinyl chloride ("PVC"),[1] and vinyl chloride monomer ("VCM").[2]

[1] Unless otherwise indicated herein, the initials "PVC" will refer to "bulk and suspension" PVC, not to other formulations of PVC.

[2] The complaint also alleged violation in a third market, *viz.*, "dispersion" PVC. However, complaint counsel elected not to pursue this allegation and no evidence was offered concerning it (see complaint counsel's trial brief, p. 2, n. 2).

Following extensive discovery, and various prehearing conferences, adjudicative hearings commenced on November 24, 1984 and continued at intervals until March 22, 1985. The evidentiary record was closed on March 26, 1985. The parties have submitted detailed proposed findings and briefs in support of their respective positions.

Any motions not heretofore or herein specifically ruled upon, either directly or by the necessary effect of the conclusions in this decision, are hereby denied.

This proceeding is before me upon the complaint, answers, testimony and other evidence, and the proposed findings of fact and conclusions of law filed by counsel supporting the complaint and by counsel for respondents. The proposed findings of fact, conclusions and arguments of the parties have been considered, and those findings not adopted either in the form proposed or in [3] substance are rejected as not supported by the evidence or as involving immaterial issues not necesssary for this decision.[3]

Having heard and observed the witnesses, and after having reviewed the entire record in this proceeding, I make the following findings:

Findings of Fact

I. THE RESPONDENTS

A. The B.F. Goodrich Company

1. Respondent Goodrich, the acquiring company, is a New York corporation headquartered in Akron, Ohio. [ ] (Complaint ¶ 3; Goodrich Answer ¶ 3; CX 8B; CX 109E *in camera;* RX 192Z–58 *in camera;* RX 312A). For the year ending December 31, 1980, Goodrich had net sales of approximately $3.08 billion, with net income of approximately $61.7 million. Its total assets at that time were listed at approximately $2.2 billion (Complaint ¶ 3; Goodrich Answer ¶ 3; CX 8Z–30, 31).

2. [ ] (CX 4Z–73; CX 22 *in camera,* CX 23A; CX 299P–S *in camera*). [ ] (CX 23A; CX 336C *in camera;* CX 662D *in camera*).

3. At the time of the acquisition, Goodrich owned and operated a

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[3] Certain abbreviations, including the following, are used in this decision:

CX - Commission's exhibit
CPF - Complaint counsel's proposed finding
RX - Respondents' exhibit
RPF - Respondents' proposed finding

The transcript of testimony is usually referred to with the last name of the witness and the page number or numbers upon which the testimony appears.

VCM plant at Calvert City, Kentucky. [ ] (CX 4Z–73; CX 109Z–3 *in camera;* DiLiddo 3353). [4]

B. Diamond Shamrock Chemicals Company

4. Respondent Diamond Shamrock, the seller of the acquired company, is a Delaware corporation headquartered in Dallas, Texas. It is a diversified international company involved in the exploration and production of natural gas and crude oil, the refining and marketing of petroleum products, the production of coal, chemicals and plastics, and the development of technology (Complaint ¶ 7; Diamond Answer ¶ 7; CX 104Z). For the year ending December 31, 1980, Diamond's sales and operating revenues were approximately $3.143 billion, with net income of approximately $201 million. Its total assets at that time were listed at approximately $2.8 billion (*ibid.;* CX 401B; CX 401Z–12).

5. At the time of the acquisition, Diamond Shamrock conducted the major portion of its PVC operations at Deer Park, Texas. This consisted of several suspension production facilities designated Plants # 1, # 3, # 4, # 4X and # 5, and one dispersion resin unit designated Plant # 2 (CX 371H-I; CX 418B). [ ] (Schaefer 1070–71; Becker 1253; CX 11B *in camera;* CX 351Q,U; CX 511B *in camera*). The combined annual nameplate capacity at Deer Park amounted to approximately 500 million pounds per year (CX 371I). [ ] (CX 11C *in camera;* CX 367A *in camera;* CX 371L; CX 418B; CX 511B *in camera;* Diamond Adm. 23–24; CX 6Z–9).[4]

6. Located adjacent to the Deer Park complex was Diamond Shamrock's Independence VCM facility at LaPorte, Texas. [ ] (Diamond Adm. 1 and 274; CX 6A and 6L; CX 295Z–44, 45 *in camera;* CX 11B *in camera;* CX 405Z; CX 414A).

C. Diamond Shamrock Plastics Corporation

7. Diamond Shamrock Plastics Corporation ("DSPC") was organized as a wholly-owned subsidiary by Diamond Shamrock in 1980 as a successor to Diamond Shamrock's Plastics Division. [5] [ ] (Diamond Adm. 308; CX 6M; CX 30Z–18; CX 367A *in camera*).

8. [ ] (Complaint ¶ 10; Answer of Diamond Shamrock ¶ 10; Goodrich Adm. 298–99; CX 4Z–12; Diamond Adm. 333–34; CX 6N; CX 295Z–94 *in camera*). [ ] (Goodrich Adm. 25; CX 4E; Arp 3502; CX 295Z–85 *in camera;* CX 11D *in camera*). [ ] (CX 3Z–583 *in camera*).

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[4] In addition, Diamond Shamrock held a [__] percent interest in a [__] million pounds-per-year bulk PVC plant in Alberta, Canada, through a joint venture with Alberta Gas Trunkline Company, Ltd. (CX 401Z–38; CX 300Z–11–13 *in camera;* CX 371A).

II. JURISDICTION

9. The question of jurisdiction is not in dispute. Both respondents Goodrich and Diamond Shamrock filed answers admitting to being subject to the jurisdiction of the Federal Trade Commission. In addition, both corporations admitted to having engaged in commerce and to being corporations whose business is in or affecting commerce within the meaning of the relevant statutes cited in the complaint (Complaint, Introductory Paragraph and ¶¶ 5, 9; Introductory Paragraphs of both Answers; Goodrich Answer ¶ 5; Diamond Answer ¶ 9).

III. THE ACQUISITION

10. [ ] (Goodrich Adm. 297–98; CX 4Z–12; Diamond Adm. 332; CX 66N *in camera;* DiLiddo 3203; CX 2Z–17,18 *in camera;* CX 11N *in camera;* CX 452).

11. [ ] (CX 2C,R *in camera;* CX 3Z–586–97 *in camera*).

12. [ ] (DiLiddo 3206–07; Schaefer 1113–14, 1175–76; Arp 3498–99; CX 2Z–10,11 *in camera;* CX 2Z–326–32 *in camera;* CX 555A *in camera*), [ ] (CX 2Z–5,6 *in camera*), [ ] (CX 3Z–285–333 *in camera*), [ ] (CX 2Z–107–18 *in camera*), [ ] (CX 2Z–326–32 *in camera*). **[6]**

13. [ ] (Schaefer 1177; CX 2Z–333–63 *in camera* and CX 2Z–374–412 *in camera*); (DiLiddo 3205–07; Schaefer 1113–16; CX 3Z–226–44 *in camera;* CX 561 *in camera*). [ ] (CX 3Z–217–23 *in camera;* CX 414Z–7; CX 453), [ ] (CX 2Z–420–587 *in camera*).

14. [ ] (Schaefer 1183; CX 300Z–25 *in camera;* CX 353J *in camera;* CX 555A *in camera*). [ ] (CX 300Z–24 *in camera*). [ ] (Schaefer 1118–19; CX 555D *in camera*). [ ] (CX 555A *in camera*). Diamond permanently closed these remaining plants in December 1983 (CX 455).

IV. RELEVANT GEOGRAPHIC MARKET

15. The parties have stipulated that the United States as a whole is the relevant geographic market within which to evaluate the likely competitive impact of the challenged acquisition (CPF 4.06, 21.01).

V. RELEVANT PRODUCT MARKET

16. The parties have also stipulated that bulk and suspension PVC is a relevant product market within which to evaluate the likely competitive impact of the acquisition (CX 4J–K; CX 6D,Z–37). The parties, however, disagree as to whether VCM constitutes a relevant market. For purposes of this decision, however, VCM has been treated as a relevant market.

A. Bulk and suspension PVC

17. Stated simply, PVC is a thermoplastic resin derived basically from the chemicals ethylene and chlorine. These chemicals are first converted into ethylene dichloride ("EDC"), from which the product VCM is manufactured by a cracking [7] process. The VCM molecules are thereafter linked together by a polymerization process to form PVC. PVC resin is manufactured in the form of white powder granules (Disch 626; McMath 1894; CX 427H).

18. [ ] (see Becker 1269–73, 1276, 1303, 1307–11, 1316–17, 1324; Eades 1464–65; Liao 1540; H. Wheeler 1727–28, 1752–53; Weber 1806–08; McMath 1895–96; Belt 1988; Yu 2093–94; RX 140Z–26 *in camera;* RX 287E-F; RX 938 *in camera*).[5]

1. PVC manufacturing processes

19. All PVC is produced by a polymerization process which links VCM molecules together in a vessel commonly referred to as a reactor, under specific temperatures in the presence of catalysts (CX 427I-K; see Disch 642; RX 125T-U; RX 218D). Reactors range in size from less than 2,500 gallons to about 50,000 gallons (see Disch 638, 640; Schaefer 1071; RX 305).

20. Within the broad category of PVC resins there are essentially three types; (1) suspension resins, (2) dispersion (or emulsion) resins, and (3) bulk (or mass) resins (CX 30G; CX 427I-K).

21. Suspension resins are produced by a polymerization process which adds suspension agents to VCM. This results in the formation of relatively large particles of PVC, and permits a low energy consumptive process to be used in the drying stage (Disch 617–29; RX 125U-W). Suspension resins account for about 85 percent of all PVC manufactured in the United States (Disch 627–28; CX 30G; RX 125T).

22. Dispersion resins are produced by a polymerization process known as emulsion polymerization, during which emulsifying, rather than suspension, agents are added to VCM to prevent the coalesence of polymer particles (Disch 630; RX 125W- [8] Y). As a result, very small particles of PVC are formed, and an expensive, energy intensive spray process must be used in the drying stage (Disch 630). [ ] (CX 518G *in camera*). As noted *supra,* n. 2, dispersion resins are not at issue in this proceeding.

23. Bulk resins are produced by a process which differs from the manufacture of suspension and dispersion resins, in that the VCM is

[5] A number of manufacturing methods are used in the production of bulk and suspension PVC end-use fabricated products. The extrusion process consists of forcing PVC resin through a die. In calendering, the resin is pressed between rolls or plates to form thin sheets. Various kinds of molding can also be employed, including injection molding for pipe fittings, compression molding for phonograph records, and blow molding for bottles (CX 427M; CX 642Z–23).

polymerized without the addition of other liquids (Disch 629; RX 125Y). Bulk polymerization consists of a two-stage process, which yields a resin comparable to suspension resin in appearance and characteristics. However, the final product is considered purer because of the absence of emulsifiers or suspension agents (CX 50V-W; CX 427K). Consequently, bulk polymerization is important for end-use applications where greater optical clarity is desired, such as in the case of packaging materials (Disch 631; see CX 427L).[6]

24. Within a general range of applications, PVC resins produced by either bulk or suspension polymerization are interchangeable. Either process can produce resins of varying molecular weight, density, particle size, and porosity. The major distinction, as noted, is purity (Disch 631–36; CX 12A).

25. Within the wide range of bulk and suspension resins, there are numerous types or grades. While there may be some disagreement as to how the various grades should be classified, industry members generally divide them into three broad categories: pipe and extrusion grade resins, general purpose grade resins, and film or specialty grade resins (Schaefer 1121; Becker 1262–63; McMath 1893).

26. The end use for a particular resin determines what molecular weight or density is required (H. Wheeler 1726–27; CX 427H). Low molecular weight resins are used to produce bottles, flooring, certain types of film, pipe, pipe fittings and other products formed by injection molding. Medium molecular weight resins are used to produce sheet, film and coated fabrics. [ ] (H. Wheeler 1726–27; McMath 1911–12, 1920; RX 266B-E *in camera*). **[9]**

2. PVC history

27. [ ] (CX 200M *in camera*). [ ] (DiLiddo 3106; CX 92G; CX 40Z–2 *in camera*).

28. The initial real growth and development of bulk and suspension PVC occurred in the 1950's and 1960's, as flexible (plasticized) PVC resin found end-use markets in wire and cable, calendered sheet, and specialty applications. [ ] (RX 639H *in camera;* see DiLiddo 3106–08).

29. [ ] (RX 639H *in camera*). [ ] (RX 639H,P *in camera*). As demand for bulk and suspension PVC resin shifted toward large volume, commodity grade end-use applications, PVC manufacturers began to install large reactors of from [__] to [__] gallon capacity to service this demand. [ ] (Disch 641, 648–653; CX 374G,Q *in camera;* CX 405R; CX 420F; CX 428Z–12).

[6] Mr. Disch of Tenneco referred in his testimony to a fourth PVC manufacturing process called solution, in which "[r]ather than water or some other medium, they use various solvents and solutions as the medium." He testified that this was "a very specialized area," accounting for less than 1 percent of U.S. capacity, with the world's only solution facility located in the U.S. (Disch 630–31).

B. VCM

30. The manufacturer of PVC depends upon a single critical feedstock—VCM—described in the Complaint as a "gaseous, reactive, acrylic intermediate chemical" (Complaint, ¶ 1.d., Goodrich Adm. 39, CX 4G; CX 427H).

31. With minor exceptions, VCM's only use is in the manufacture of PVC. [ ] (DiLiddo 3301; L. Wheeler 918–19; CX 46A; CX 200M *in camera;* CX 376L *in camera;* CX 404Z–15; CX 427W; CX 642Z–7).

32. VCM is produced by thermally cracking purified EDC at high temperatures (Wheeler 918–26; Keinholz 756–58); the EDC having been produced in a VCM plant by two related processes: oxyhydrochlorination of ethylene and direct chlorination of ethylene. [ ] **[10]** (Goodrich Adm. 44–45; CX 4G; Diamond Shamrock Adm. 44–45; CX 6C; L. Wheeler 917, CX 18A; CX 355B *in camera;* CX 427I).[7]

VI. PVC QUANTITATIVE ANALYSIS

A. U.S. PVC producers

33. At the time of the acquisition in January 1982, there were seventeen producers of bulk and suspension PVC in the United States.[8] [ ] (CX 664U; CX 661Z–14 *in camera*).

34. [ ] (CX 662D *in camera*), [ ] (CX 662F *in camera*). [ ] (CX 661Z–16 *in camera;* **[11]** CX 664R *in camera*). [ ] (CX 664C,J,R *in camera*).

35. Diamond Shamrock ranked [__] in industry nameplate capacity and [__] in industry practical production capacity at the time of the acquisition. [ ] (CX 662D *in camera;* CX 662F *in camera*). The Deer Park, Texas Plant #5, the one acquired by Goodrich, represented [__] percent of 1982 industry nameplate capacity and [__] percent

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[7] Initially, VCM was produced by the hydrochlorination of acetylene (CX 40Q *in camera;* CX 39T *in camera;* CX 200H *in camera*). Prior to 1960, virtually all VCM in the United States was made using acetylene as the primary feedstock (RX 57U *in camera*). However, acetylene supply became inadequate to support the growing demand for VCM following World War II. As a result, the VCM industry began shifting to ethylene-based technology during the 1950's, when development in the petrochemical industry provided a plentiful ethylene supply (CX 40R *in camera;* CX 39U *in camera;* CX 200I *in camera;* RX 57U *in camera*). In 1963, Goodrich developed the "oxyhydrochlorination" process, which, by utilizing the byproduct from the primary production stage, completely eliminated acetylene from the VCM process (CX 40R *in camera;* CX 39U *in camera;* CX 92G). Today, ethylene-based technology, with its subsequent refinements, continues to be the VCM production technology of choice world-wide (CX 40R *in camera;* CX 39U *in camera*). All VCM plants that have been built since the late 1960's have employed the ethylene technology (see, *e.g.,* RX 57W-X *in camera;* Goodrich Adm. 43, CX 4G; Diamond Shamrock Adm. 43, CX 6C).

[8] These seventeen producers were: The B.F. Goodrich Company, Tenneco Polymers, Inc., Georgia-Pacific Corporation, Shintech Incorporated, Occidental Chemical Corporation, Diamond Shamrock Chemicals Co., Conoco, Inc., Borden, Inc., Air Products & Chemicals, Inc., CertainTeed Corporation, Formosa Plastics Corporation, Stauffer Chemical Company, The General Tire & Rubber Co., Ethyl Corporation, Great American Chemical Corp., Keysor-Century Corporation, and Pantasote, Inc.

of industry practical production capacity.[9] [ ] (CX 661Z–16 *in camera;* CX 664B *in camera*).

36. Tenneco Polymers, Inc. ranked [__] among bulk and suspension PVC producers in both industry nameplate and practical production capacities at the time of the acquisition. [ ] (CX 662D,F *in camera*). [ ] (CX 661Z–28 *in camera;* CX 6640,U *in camera*).

37. [ ] (CX 662D,F *in camera*). [ ] (CX 661Z–28 *in camera;* CX 664Q *in camera*).

38. Shintech Incorporated ranked [__] in practical production capacity and [__] in nameplate capacity immediately prior to the acquisition. [ ] (CX 662D,F *in camera*). [ ] (CX 661Z–28 *in camera;* CX 664T *in camera*). [12]

39. In January 1982, Conoco, Inc., ranked [__] in industry nameplate capacity and [__] in industry practical production capacity. [ ] (CX 662D,F *in camera*). [ ] (CX 661Z–28 *in camera;* CX 664P *in camera*).

40. [ ] (CX 662D *in camera*). [ ] (CX 313A-Q *in camera;* CX 662F *in camera*). [ ] (CX 664S *in camera*).

41. (CX 662D,F *in camera*). In 1981, Borden also ranked [__] in bulk and suspension PVC production, with a market share of [__] percent (CX 661Z–28 *in camera;* CX 664P *in camera*).

42. Air Products and Chemicals, Inc., ranked [__] in the production of bulk and suspension PVC by all measurements in January 1982. [ ] (CX 662D,F *in camera*). [ ] (CX 661Z–28 *in camera;* CX 664"O" *in camera*).

43. CertainTeed Corporation was the [__] ranking PVC producer in all categories of measurement prior to the acquisition. [ ] (CX 662D,F *in camera*). [ ] (CX 661Z–28 *in camera;* CX 664 *in camera*).

44. Formosa Plastics Corporation ranked [__] in PVC production capacity in January 1982. At the time of the acquisition Formosa accounted, respectively, for [__] percent and [__] percent of PVC nameplate and practical production capacities (CX 662D,F *in camera*). In 1981, Formosa ranked [__] in the production of PVC with a market share of [__] percent (CX 661Z–28 *in camera;* CX 664Q *in camera*). [ ] (CX 662D,F *in camera*). [13]

45. Prior to the shutdown of its Long Beach, California suspension PVC plant in March 1982, Stauffer Chemical Company ranked [__] in 1982 nameplate and practical production capacity, with a market share by these respective measurements of [__] and [__] percent (see CX 318A–Q *in camera;* CX 662D-F *in camera*). Stauffer ranked [__] in

[9] Viewed as a stand alone entity, Diamond's PVC Plant # 5 would have ranked as the [__] largest firm in the bulk and suspension PVC industry in both nameplate and practical production capacity. And Diamond's remaining Deer Park PVC operations would have ranked [__] in nameplate capacity with a market share of [__] percent and [__] in practical production capacity with a market share of [__] percent (CX 662D,F *in camera*).

1981 bulk and suspension PVC production, holding a market share of [__] percent (CX 661Z–28 *in camera;* CX 664T *in camera*).

46. At the time of the acquisition, General Tire & Rubber Company (renamed "GenCorp") ranked [__] in nameplate capacity with a market share of [__] percent, and [__] in practical production capacity with a market share of [__] percent (CX 662D,F *in camera*). The 1981 figures place GenCorp [__] in PVC production, with a market share of [__] percent (CX 661Z–28 *in camera;* CX 664I *in camera*).

47. Ethyl Corporation ("Ethyl") was the [__] ranking PVC producer measured by industry nameplate capacity with a market share of [__] percent prior to the acquisition (CX 662D *in camera*). Ethyl and Stauffer both ranked [__] in PVC practical production capacity for the same period, each accounting for [__] percent of the market (CX 662F *in camera*). In 1981, Ethyl ranked [__] in actual PVC production, with a market share of [__] percent (CX 661Z–28 *in camera*).

48. At the time of the acquisition, Pantasote accounted for less than [__] percent of PVC industry capacity (CX 662D,F *in camera*). During the year prior to the acquisition Pantasote ranked [__] in bulk and suspension PVC production with a market share of [__] percent (CX 661Z–28 *in camera;* CX 664S *in camera*).

As for Talleyrand, Great American Chemical Corporation and Keysor-Century Corporation, each accounted for less than [__] percent of the bulk and suspension PVC market in 1981 (CX 661Z–28 *in camera*). In September 1981, Talleyrand ceased production and exited the market (CX 319B). Great American and Keysor-Century individually accounted for less than [__] percent of 1982 bulk and suspension industry capacity (CX 662D,F *in camera*).

B. Concentration in the bulk and suspension PVC market

1. The effect of the acquisition on concentration

49. Goodrich's acquisition of Diamond Shamrock's Deer Park, Texas, suspension PVC Plant # 5 resulted in an increase in concentration in the bulk and suspension PVC market. Measured by the Herfindahl-Hirschman Index ("HHI"), nameplate capacity increased by 113 points to a level of 1,098, while the practical production HHI rose 112 points to a level of 1,079 (CPF 5.27–.28). **[14]**

50. By virtue of the acquisition, four-firm concentration in PVC nameplate capacity rose 4.0 percent to a level of 54.2 percent, rounded to the nearest decimal (CPF 5.27). Four-firm concentration in PVC practical production capacity also increased, rising 4.3 percent to a level of 53.5 percent (CPF 5.28).

51. As for eight-firm concentration figures, in nameplate capacity the acquisition increased concentration by 0.8 percent, to a level of

82.4 percent (CPF 5.27), while there was no change in the practical production capacity figure of 81.5 percent (CPF 5.28).

52. Goodrich's leading position in the PVC market was enhanced by virtue of the acquisition. Its share of PVC nameplate capacity increased from [__] percent to [__] percent, and its share of practical production capacity rose from [__] percent to [__] percent (CPF 5.27-.28).

53. Because actual production figures attributable to Plant # 5—apart from Diamond's overall output—could not be identified in the record, changes in concentration calculated on that basis were not included in the proposed findings. However, a comparison of 1981 and 1982 market shares in actual PVC production shows that Goodrich's market share increased from [__] percent to [__] percent, while Diamond Shamrock's share of industry production fell from [__] percent to [__] percent (CX 661Z-16 *in camera;* CX 664P,R *in camera*). Four-firm concentration also increased between 1981 and 1982, rising from [__] percent to [__] percent (CX 661Z-16 *in camera*).[10] And the Herfindahl Index rose 221 points to 1131 (CX 661Z-16 *in camera*).

2. Concentration trends

54. The record shows an overall increase in concentration in the bulk and suspension PVC market over the past several years. From 1977 to 1985, nameplate capacity HHI increased from 720 in 1977, to 1203 in 1985 (see table at CPF 5.69). In this period, eight-firm concentration also increased from [__] percent in 1977 to [__] percent in 1985. Four-firm concentration increased from [__] percent in 1977 to [__] percent in 1985, while the two-firm figures are [__] percent and [__] percent. Practical production capacity and actual production data reflect similar increases in concentration over the same time period (see CX 664M,N *in camera*). **[15]**

55. It appears that from 1970 to 1975, entries offset exits in the PVC business. Between 1974 and 1975, Georgia Pacific, Formosa, CertainTeed and Shintech (a joint venture between Shin-Ebi of Japan and Robintech) began production of bulk and suspension PVC (CPF 5.69; CX 344B). [ ] (CX 321B *in camera;* CX 357A *in camera;* CX 359F; CPF 5.69). In addition, several PVC producers sold their manufacturing facilities to newcomers and exited the industry during this period (CX 442B-C). In 1970, Airco, Inc. sold its Chemical and Plastics Division to Air Products & Chemicals, Inc. (CX 323A). And in 1973, Allied Chemicals Corporation sold its polyvinyl chloride manufacturing facility to Robintech Incorporated (CX 325A). By 1975, there were

[10] Two-firm concentration increased from [__] percent in 1981 to [__] percent in 1982; eight-firm figures are [__] percent in 1981 and [__] percent in 1982 (CX 661Z-16 *in camera*).

22 producers of bulk and suspension PVC, an increase from 19 in 1971 (CPF 5.69).

56. *De novo* entry has not occurred in PVC production since 1975. [ ] (CX 317C *in camera;* CX 307B *in camera;* CX 318A,D *in camera;* CX 300Z–6 *in camera;* see 306B *in camera*). [ ] (CX 326C *in camera*). [ ] (CX 326C *in camera*). [ ] (CX 319A,B; CX 326C *in camera*). [ ] (CX 317C *in camera*). [ ] (CX 41A, *in camera;* CX 53W *in camera*). [ ] (CX 307B *in camera*). The following year, Stauffer Chemical Company sold its Delaware City, Delaware PVC plant to Formosa Plastics Corporation. [ ] (CX 318A,D *in camera*). [ ] (CX 300Z–6 *in camera;* see CX 306B *in camera*). (see CX 116 *in camera;* CX 561 *in camera*).

57. Since 1975, several firms have shut down their facilities and left the PVC business. Union Carbide exited the PVC market in 1977, following a destructive explosion at its plant (CX 43B; CX 108Q). [ ] **[16]** (CX 322A,C *in camera*). Two years later, GenCorp and Pantasote, Inc. both closed their respective PVC plants and left the industry (CX 388; H. Wheeler 1720–21; see H. Wheeler 1774).

58. Since the Goodrich acquisition in January 1982, the number of firms engaged in the production of bulk and suspension PVC has declined from 17 to 11 (CPF 5.67).

VII. PVC QUALITATIVE ANALYSIS

A. Entry considerations

59. Complaint counsel's economic expert speaks of "entry conditions," rather than "entry barriers,"[11] describing these as "anything that exists in the industry" which will (1) delay entry in response to the existence of supracompetitive profits; (2) reduce the magnitude of the entry response; and (3) reduce the probability of entry (Kaserman 2311). In this connection, Dr. Kaserman identified "five basic factors" which ought to be considered (Kaserman 2314–15). Each is addressed, *infra.*

1. Minimum efficient scale plant

60. According to a number of industry witnesses, the minimum efficient scale for PVC manufacturing plants is in the 300–600 million pounds-per-year range. Mr. Disch of Tenneco estimated the minimum efficient scale to be at least 300 million pounds, but noted the presence of further scale economies in plants larger than that (Disch 644). Mr.

[11] Apparently, there is agreement by the expert economists on both sides that there are no "Stigler type" entry barriers in the PVC industry (Kaserman 2828, 2831–32; Klass 4423). According to the testimony, a Stiglerian entry barrier is generally considered to be a production cost which must be borne by a company seeking to enter an industry, but not borne by an industry participant (Kaserman 2312, 2833; Klass 4424). For example, a Stiglerian barrier exists where incumbent firms have exclusive access to a particular productive raw material, or a prohibitive patent advantage (Kaserman 2832–33).

Schaefer, formerly of Diamond, testified that the minimum size was 300 million, with expansion potential to 500–600 million pounds (Schaefer 1132).[12] Goodrich believed that there were scale economies in a 550 million pounds-per-year facility beyond those inherent in a 300 million pound plant (DiLiddo 3345). The estimate of ICI's Dr. Eades was approximately 500 million pounds (Eades 1462–**[17]** 63). Mr. Howard Wheeler of GenCorp was of the opinion that the minimum efficient scale for a bulk or suspension PVC plant was 600 million pounds-per-year, but that 750 to 900 million pounds would be perferable (H. Wheeler 1734–35).

61. Apart from the above testimony, the record shows that in 1983 the Borden and Formosa companies each completed construction of new plants with nameplate capacities of [__] and [__] million pounds, respectively (CX 302G *in camera;* CX 308E). And the planned Goodrich suspension PVC facility at Convent, Louisiana was designed to have a [__] million pounds per year capacity (DiLiddo 3345; CX 38 *in camera*).

62. [ ] (CX 14F *in camera;* CX 515). Today there are a number of plants in the industry with a nameplate capacity larger than [__] million pounds: Georgia Gulf ([__] million pounds) (CX 301D *in camera*); Tenneco ([__] million pounds) (Disch 637); Formosa Plastics ([__] million pounds) (CX 308E); Shintech (two plants, with total capacity of [__] billion pounds) (compare CX 317B,C *in camera* and McMath 1892).

2. Sunk costs

63. Complaint counsel's economic expert, Dr. Kaserman, identified "sunk costs" as costs incurred upon entering an industry which cannot be retrieved upon leaving that industry (Kaserman 2321–22). In assessing the magnitude or significance of sunk costs in the PVC industry, it must be realized that bulk and suspension PVC plants are specialized, suitable only for the manufacture of PVC (Disch 686). There was testimony that it would be very difficult to convert a PVC plant to any other use, and that, in fact it might be easier to start afresh and build a new plant for such purpose (H. Wheeler 1724–25, 1744–45). Some industry witnesses placed sunk costs as being 75–80 percent of the total value of a PVC facility (H. Wheeler 1744–45; Schaefer 1219), with total costs for an efficient sized plant exceeding $100 million (Schaefer 1211–12; Diamond Adm. 450, CX 6S). There was testimony that the industry recognizes that investment in a new plant would entail considerable financial risk (DiLiddo 3134–3137),

[12] In 1981, Diamond Shamrock, in response to an HSR request, estimated the minimum size to be 300 million (CX 445).

and that, should it be necessary to close a plant, virtually the entire investment could be lost (Liao 1521–22; see DiLiddo 3396).

3. Required lead time

64. There is record evidence that the time required for planning, permitting and constructing a bulk or suspension PVC plant may be as long as [__] to [__] years (CX 15A; CX 16B, Z–10 *in camera;* CX 182I *in camera;* CX 196A *in camera;* CX 439B; CX 446C; see Diamond Adm. 445, CX 6S). **[18]**

65. As for actual construction of the plant, the time needed is approximately two years (Schaefer 1134; McMath 1940; Disch 653; see also CX 446C).

66. Prior to beginning plant construction, however, it is necessary to obtain certain environmental permits (Schaefer 1133; CX 597; CX 642; CX 643; Diamond Adm. 443, CX 6S; Goodrich Adm. 400, CX 4Z–23).[13] Securing such permits is often a costly and time-consuming process (Diamond Adm. 415, CX 6Q), [ ] **[19]** (Schaefer 1133; CX 38V *in camera;* CX 506B *in camera;* CX 592 *in camera*).[14]

67. In addition, certain engineering work must be performed even before applying for regulatory permits, since the resulting information must be presented in the permit applications (DiLiddo 3337).

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[13] Air emissions from VCM and PVC plants are subject to the restrictions of the Clean Air Act, as amended, 42 U.S.C. 7401–7642. Both plants are subject to specific air-quality standards restricting vinyl chloride emissions in accordance with the National Emissions Standard for Vinyl Chloride, 40 CFR 61.60–.68, promulgated pursuant to the National Emission Standard for Hazardous Air Pollutants (NESHAP, 42 U.S.C. 7412). In addition, the Prevention of Significant Deterioration (PSD) regulations include vinyl chloride as a pollutant covered under the regulations, with a one ton per year emission rate as the triggering amount, 40 CFR 51.24(b)(23), 52.21(b)(23). New VCM and PVC plants, as well as major expansions of existing facilities, may otherwise be subject to federal PSD requirements as major potential sources of any of the other air pollutants subject to regulation under the Clean Air Act, including the need to obtain preconstruction permits, 42 U.S.C. 7470–7479; 40 CFR 51.24, 52.21. Federal PSD air emission requirements apply only to sources locating in areas presently meeting the National Ambient Air Quality Standards (NAAQS), 42 U.S.C. 7407(d), 7475. For new or existing sources locating or located in "nonattainment areas," a more stringent set of regulations applies. 42 U.S.C. 7501–7508; 40 CFR 52.24. See also 40 CFR Part 51, Appendix S ("Emission Offset Interpretative Ruling").

Effluent discharges from VCM and PVC resin plants are subject to the restrictions of the Clean Water Act, as amended by the Federal Water Pollution Control Act, 33 U.S.C. 1251–1376. Vinyl chloride has been specifically designated by the EPA as a toxic pollutant under the Act, 33 U.S.C. 1317; 40 CFR 401.15, and polyvinyl chloride manufacturing facilities have been identified as a category of pollutant discharge point sources, 33 U.S.C. 1316(B)(1)(A), see 40 CFR 401.12, 416.10–.15. New and existing VCM and PVC manufacturing facilities hence are subject to the permit requirements of the National Pollutant Discharge Elimination System (NPDES) program as potential sources of the discharge of pollutants, 33 U.S.C. 1342. In addition, VCM or PVC plants may also be subject to local regulations, particularly land use requirements.

[14] Such regulatory requirements were viewed by Goodrich as significantly affecting the total lead time for plant construction and the risk of new plant investment:

> Complicating the development and implementation of new processes is the long lead time required for plant expansions and constructing grass root PVC plants. This is now four to five years vs. the three years formerly required due to the increasing number of local and federal restrictions and necessary approvals. The result is R&D's time table to freeze a plant design is drastically shortened requiring front-end loading of programs and skilled prioritizing of the resources to get the job done in time to have a maximum impact. This is especially difficult with new technologies which usually require the building and operation of a pilot plant before design data for a manufacturing plant can be generated. By-passing stages in process development to meet the shorter time tables will significantly increase the risks of long costly plant start-ups and not meeting planned capacity goals.

(CX 196A *in camera;* see also CX 67Z–7 *in camera;* CX 183D *in camera*).

[ ] (DiLiddo 3337; CX 183D *in camera*). This pre-permit engineering, according to Goodrich, could take approximately six months (DiLiddo 3337). And in 1980, EPA amended its Prevention of Significant Deterioration Regulations to require that air quality near the site might have to be monitored for a period of time prior to applying for permits (40 CFR 51.24(m), 40 CFR 52.21(m)). This latter factor could add even additional time to the permit process (CX 446D; CX 574J; see also Kienholz 803–04).

68. Another factor to be considered prior to filing for permits, is selecting a site for a new facility. This, in itself, can be a "complicated" process (see DiLiddo 3335–36), involving *inter alia*, raw material and finished product logistics, community acceptance, labor supply, labor relations, political climate, and the availability of local support services (CX 574I,M-U; see also CX 193B; CX 643; CX 594A-B; RX 1061D-E; RX 1304; RX 1308). [**20**]

69. Furthermore, additional time may be needed for a new entrant to evaluate and obtain licenses for needed PVC manufacturing technology. There was testimony that this could take approximately one year (Disch 646–7; Schaefer 1133). And, since entry into the PVC industry is a major strategic decision involving substantial amounts of capital, a new entrant will more than likely have to conduct an extensive study and analysis of the market prior to making an entry decision (see CX 594A-B; CX 53A).

70. Recent entry experience evidences the length of entry lead time. Formosa Plastics began looking for a site for its PVC/VCM complex in the latter part of 1978 (Liao 1523–24). The facility "started running" in December of 1982, and did not "have full production" until the first quarter of 1983.[15]

71. Another record example is Goodrich's suspension PVC plant project at Convent, Louisiana. [ ] (DiLiddo 3335–37; CX 36S *in camera*). Prior to the July 1979 announcement, Goodrich had completed an extensive PVC/VCM strategy study over an eight-month period (DiLiddo 3334–35; CX 53A). During these eight months, Goodrich had also completed a complicated site selection process and had chosen the Convent, Louisiana site (DiLiddo 3335–36). The company was also planning to utilize its own in-house technology (DiLiddo 3336).

72. And again, in 1981, Diamond Shamrock projected the lead time for a new suspension PVC plant at Deer Park, Texas, using Diamond Shamrock technology, to be four to five years "from concept to start-up" (CX 439B).

[15] This time period does not include any strategic analyses which might have been done prior to Formosa's search for a site. Furthermore, Formosa possessed or had access to production technology (Liao 1539), and had some experience in the industry by virtue of its participation in the Rico Chemicals project (Liao 1519–22).

4. Excess capacity

73. Capacity utilization rates in the bulk and suspension PVC industry over the 15-year period 1970–1984 are shown in the tables set forth at CPF 17.03.

74. The recent period of low capacity utilization, in 1980–1982, coincided with a time of economic recession in the United States. And there was testimony that a demand for PVC in [21] industry reflected this general state of economic activity (see DiLiddo 3116–18; Eades 1471–73).

75. Various industry witnesses generally viewed the recent period of low capacity utilization as being transitory, and that utilization rates will gradually increase throughout the 1980's (Disch 691–92; Schaefer 1123, 1125; Eades 1473–74, 1480; H. Wheeler 1736–37; CX 220C).

5. Extent of vertical integration

76. [ ] (CX 667 *in camera*), [ ] (CX 667I-J *in camera*).

77. The evidentiary record contains a chart, RX 246A which depicts the various patterns of ownership integration among the industry's producers as of 1984.

78. As evidenced by RX 246A, the pattern of integration among the producers varies:

(1) Goodrich, Formosa and Georgia Gulf are fully integrated by ownership into PVC and VCM, with manufacturing facilities at each of the six stages of the PVC production chain: (1) chlorine and/or ethylene; (2) EDC; (3) VCM; (4) bulk and/or suspension PVC; (5) PVC compounding; and (6) PVC fabricating.

(2) Borden and Conoco are almost fully integrated by ownership into PVC and VCM with manufacturing facilities at five of the six production stages. However, as depicted, Borden does not produce chlorine and/or ethylene and Conoco does not have a PVC fabricating facility.

(3) The seven remaining PVC producers—Air Products, Certain-Teed, Keysor-Century, Occidental, Pantasote, Shintech and Tenneco —do not produce VCM. According to the chart, their degrees of downstream integration are varied. While Air Products and Shintech do not own PVC compounding or fabricating facilities, Tenneco owns a PVC compounding, but not a PVC fabricating facility, and Certain-Teed, Keysor-Century, Occidental and Pantasote own both PVC compounding and fabricating facilities. [22]

(4) Finally, the three remaining VCM producers—Shell, PPG and

DOW—have no downstream integration into any phase of PVC production and their degrees of upstream integration vary.

6. Entry and expansion experience

79. [ ] (see Kaserman 2341–44; CX 664G *in camera*).[17]

80. [ ] (CX 664G *in camera;* RX 1182A; see CX 303H *in camera;* CX 310D *in camera;* CX 355A *in camera*).

81. Industry capacity further increased from 1976 to 1978 when a number of firms, including Air Products, Borden, CertainTeed, Formosa, Goodrich, Goodyear, Conoco, Diamond, Tenneco, and Shintech expanded their PVC businesses, generally adding large reactor capacity (see Klass 4074–75; RX 1182A).

82. (CX 15A; CX 164C *in camera;* see Disch 691–92; Schaefer 1122). During this period Formosa undertook construction of a grassroots PVC plant in Point Comfort, Texas, which commenced **[23]** actual operations in 1983 and has a production capacity of approximately 530 million pounds per year (Liao 1533–35; CX 308E). Similarly, during 1979, Georgia Pacific, Air Products, Goodrich, Tenneco and Imex expanded their PVC production capabilities, and one year later Diamond and Georgia Pacific incrementally increased their PVC production capabilities (RX 1182A).

83. Finally, there has been new plant construction by Borden and Formosa and expansions by Conoco, Shintech and Air Products as of 1983 and 1984 (McMath 1892; DiLiddo 3285; RX 687A; RX 820A; RX 1182A).

84. There was testimony that, at present, the PVC market is burdened with excess capacity and poor financial returns (Yu 2173–75; H. Wheeler 1736; DiLiddo 3282–84). [ ] (L. Wheeler 1031–32 *in camera;* Schaefer 1211–13; DiLiddo 3285–87; see CX 513C *in camera*).

B. PVC homogeneity

85. Bulk and suspension PVC resins are produced and sold in several grades, distinguished by differences in particle size, molecular weight, and purity (Disch 632, 634–35; Becker 1255–57). These grades are designed to meet particular applications and end-use requirements of purchasers (Disch 634; Diamond Adm. 166; CX 6H).

86. Within the various grades, there appears to be little variation

[17] This assumes that the entry of Formosa Plastics is counted as of the date of its involvement in the Rico Chemical project, rather than from its acquisition of Stauffer's Delaware City facility, or construction of its own Point Comfort, Texas plant.

Formosa entered the PVC business in 1974 with the construction of its RICO plant in Puerto Rico. From 1974 through 1980 Formosa's sales never exceeded 3 percent of the market and in 1981 the RICO plant was closed (CX 664C). In that year, Formosa purchased a small PVC facility, with a nameplate capacity of 255 million pounds per year, from Stauffer Chemical, and in 1983 it completed construction of and commenced PVC production at a 530 million pound per year plant at Point Comfort, Texas (CX 664C; RX 303C).

in overall quality among PVC producers (Disch 725; RX 309Z–11), with "major PVC end use markets" being described as "not quality conscious" (RX 34S).[18]

87. [ ] (Disch 725; CX 406Z–6; *in camera*). Commodity grade resins were estimated by one industry witness to account for approximately 75 percent of bulk and suspension PVC sales (Weber 1795). There was testimony that commodity grade resins are by and large considered to be "me-too" products, with no real claims that one supplier's resin is better than another's (Disch 719, 725; see also Becker 1331). Thus, according to Tenneco's Mr. Disch, pipe customers will switch resin suppliers over small differences in price (Disch 707). And there was further **[24]** testimony that no supplier can maintain a premium price for its commodity grade over those of other suppliers (Becker 1264–65; Schaefer 1139, 1202–03).

88. [ ] (H. Wheeler 1750–51; Becker 1263–64; DiLiddo 3374–75; RX 152Z–6 *in camera*). As to these, some industry witnesses perceived certain differences in inherent physical properties (Disch 725; Becker 1331, 1333–34). While "specialty grades command a small premium over what is called the commodity rate" (H. Wheeler 1750–51), suppliers of these products are not able to maintain such premium over the prices of similar grade resins of competing producers (Becker 1264–65; H. Wheeler 1750–51).

89. Producers sometimes provide technical service in conjunction with the sale of PVC (Becker 1331–32). Such service is relatively more significant in the sale of specialty grades than commodity grades (Becker 1330–31; Weber 1794–96). In the specialty area, the providing of technical service could cause a customer to prefer to continue dealing with its regular supplier, and afford that supplier the opportunity to meet competitive offers (Becker 1330–32; Schaefer 1202–03). Nevertheless, for the bulk and suspension PVC market as a whole, service is considered relatively unimportant (Schaefer 1202–03; CX 199U).

90. [ ] (Eades 1461; CX 518F *in camera;* RX 34T; RX 54B *in camera*), where buyers will switch suppliers over small differences in prices (DiLiddo 3372). Purchasers of bulk and suspension PVC generally select the lowest price resin grade suitable for a particular processing or end-use requirement (Diamond Adm. 177; CX 6H).

91. Respondents urge, however, that the question of homogeneity in this case properly involves an analysis of what they term "commercial heterogeneity:" whether PVC resin is produced and sold on a uniform basis or according to varying terms and practices (Klass 4333–34). As to this, respondents assert that there are a number of material terms

[18] There was testimony from one industry witness that "the same resins from different suppliers are not exactly the same" (H. Wheeler 1748; see also RX 175Z–2–5 *in camera*).

and conditions which distinguish ways in which PVC is sold and purchased (DiLiddo 3250, 3252–53; see Becker 1338; H. Wheeler 1768–69; McMath 1960; RX 577S).

92. [ ] (Disch 685–86; Schaefer 1134, 1203; Becker 1338; McMath 1960; DiLiddo 3250, 3252–53; RX 144A-B *in* **[25]** *camera;* RX 177A *in camera;* RX 212B *in camera;* RX 585R; RX 1240C *in camera*).[19]

93. [ ] (Disch 685–86; Becker 1330–32; DiLiddo 3252–53; RX 259B *in camera;* RX 554C; RX 887A *in camera;* RX 1213Q-W *in camera;* RX 1240C *in camera;* see RX 212B *in camera*).

C. Demand for bulk and suspension PVC is relatively inelastic

94. Complaint counsel's economic expert, Dr. Kaserman, testified that in performing his analysis of the elasticity of demand for bulk and suspension PVC, he attached significance to the fact that PVC is an "intermediate product" rather than a consumer good. Dr. Kaserman testified that the price elasticity of demand for an intermediate product is a function of three factors: (1) the ease of substitutability between the intermediate product and other inputs in the production of the final product; (2) the cost share of the intermediate product in the production of the final products; and (3) the price elasticity of demand for the final products produced from the intermediate product (Kaserman 2370–71).

1. There are no practical substitutes for PVC resin in the manufacture of finished PVC products

95. The record indicates that there are no substitutes for bulk and suspension PVC resin in the manufacture of finished PVC goods (Kaserman 2376–77). PVC resin is the primary raw material input in the fabrication process, providing the properties necessary to give the product its fundamental form (see H. Wheeler 1751–52; Disch 661–62). Moreover, producers of PVC finished products testified that PVC manufacturing equipment cannot easily or practically process other materials (Wheeler 1751–52; Disch 663).

2. The cost share of PVC resin in many finished PVC products is low

96. Bulk and suspension PVC resins account for only a small portion of the cost of PVC finished products. Value is added to PVC resin at various points in the manufacturing process, thereby **[26]** reducing the cost share of the PVC resin in the final product. Initially, PVC resins are compounded in order to impart certain desired properties

[19] Contrast RX 267A *in camera* (60–day credit terms) with RX 895A *in camera* (45-day credit terms) and with RX 268A *in camera* (30–day credit terms).

to the product prior to its use in fabricating end products (Disch 655–56). Compounding involves infusing the resin with various additives, including heat and light stabilizers, impact modifiers, plasticizers, and pigments (Disch 656–57). The amount of value added at the compounding stage varies. Flexible compounds used in the manufacture of wire, cable, and flexible sheathing require the addition of plasticizers, and frequently contain no more than 50 to 70 percent resin by weight (Disch 658–59; DiLiddo 3377). On the other hand, rigid compounds used in the manufacture of bottles, pipes, and fittings, require expensive additives, and others contain as much as 80–95 percent resin by weight (Disch 659–60; Becker 1300). In addition, value is added to PVC compounds at the manufacturing stage through a number of production processes, including extrusion, calendering, blow-molding, injection molding, and compression molding (Disch 661–62). Once again, the value added varies with each PVC product (see CPF 8.70; CPF 8.77; CPF 8.92; CPF 8.97; CPF 8.105; CPF 8.113; CPF 8.124). Finally, PVC resin accounts for a very small portion of the total installed cost of PVC products such as pipe, siding and windows (see CPF 8.70; CPF 8.92; CPF 8.113). As a result, Dr. Kaserman concluded that the low cost share of PVC resin in PVC consumer goods indicates that the demand for bulk and suspension PVC resin in significantly less elastic than the demand for the products themselves (see Kaserman 2373–75).

3. The price elasticity of bulk and suspension PVC finished products is low

97. Bulk and suspension PVC resin is used in the manufacture of hundreds of end-use products. [ ] (see Disch 663–80; Becker 1268–1325; H. Wheeler 1727–28, 1753; CX 591G-K *in camera;* see Commission physical exhibits 1–17).

98. The record indicates that two factors account for the general inelasticity of demand for PVC end products and the relatively low substitutability of products manufactured from other materials. First, the evidence establishes that many PVC products possess unique characteristics which make them highly desirable in a variety of end-use applications (Yu 2118–29; Becker 1274–79; DiLiddo 3348–50; Disch 672–77). Consequently, PVC finished products are often selected on the basis of their distinctive properties, and not on the basis of changes in price (Yu 2188–29; Becker 1274–79; DiLiddo 3348–50; Disch 672–77). And second, a number of PVC finished products offer substantial cost savings to purchasers, comparing favorably in price with products manufactured from other materials (CPF 8.126). **[27]**

4. PVC finished end products

a. Pipe and pipe fittings

99. The production of PVC pipe accounts for approximately [__] percent of the annual consumption of bulk and suspension PVC resin (Disch 663; see also RX 145L *in camera;* Commission physical exhibit 6). PVC pipe fittings, which are used in conjunction with PVC pipe (Becker 1323–24), account for an additional 3–4 percent of PVC resin consumption (Disch 663; see Commission physical exhibit 7). PVC pipe first gained commercial prominence in the late 1960's and early 1970's (Becker 1276–78). During the period 1966–1968, the PVC pipe segment consumed approximately 134 million pounds of bulk and suspension PVC (RX 3Z–14). By 1983, however, demand has grown to about [__] million pounds (RX 165E *in camera;* see generally CX 756Z–19).

100. The record establishes that PVC pipe possesses a number of characteristics that compare favorably with pipe products manufactured from traditional materials.[20] These distinctive properties include: low cost, light weight, long lengths, ease of joining, ease of installation, corrosion resistance, smooth interior walls, and excellent flow efficiency.[21] These factors are examined in some detail, as follows:

101. In many of the applications for which it is used, there is evidence that PVC pipe is more cost-effective than alternative pipe materials (CX 591H *in camera;* CX 247A,L *in camera;* RX 958A; see also Becker 1293–94). Comparing the cost of manufacture alone, the record reflects that alternative materials cost appreciably more to produce (CX 247A,L *in camera*).

102. In addition, PVC pipe possesses qualities which make it easier to handle and less costly to install than most other pipe products. Mr. Andrew Yu of J.M. Manufacturing Company, Inc. testified that PVC pipe is substantially lighter in weight than traditional pipe materials, weighing approximately 30 percent as much as concrete pipe and 25 percent as much as ductile iron [28] (Yu 2122–23). Mr. Yu further testified that the relatively light weight of PVC pipe facilitates installation by hand labor, enabling contractors to dispense with heavy equipment required to lay ductile iron or cement pipe (Yu 2123–24; DiLiddo 3347–48). Moreover, PVC pipe is manufactured in longer lengths than pipe made from traditional materials (Yu 2123–24; Wag-

[20] Traditional pipe materials which compete with PVC pipe include: clay, asbestos cement, concrete, steel, ductile iron, copper, and aluminum (see *e.g.,* CX 244F; CX 49K).

[21] See generally CX 591H *in camera;* CX 247A, L *in camera;* RX 958A; Becker 1293–94 (PVC pipe is low in cost); Yu 2122–27, DiLiddo 3347–48; Waggoner 3632 (PVC pipe is lighter and less costly to install than most traditional pipe); Yu 2121–22; DiLiddo 3348–50; Becker 1274 (PVC pipe is resistant to corrosion from chemicals); Yu 2118–21; Becker 1276–78; Waggoner 3576 (PVC pipe has excellent flow properties).

goner 3632). As a result, PVC pipe requires fewer joints in the installation process, permitting workers to lay pipe more quickly (Yu 2125–27; Waggoner 3632). [ ] (Yu 2123–27; CX 247A *in camera*).[22]

103. In addition, PVC pipe is resistant to certain corrosive chemicals that affect other kinds of pipe. Acidic, alkaline or wet soils do not cause the external walls of PVC pipe to corrode (Yu 2121–22; DiLiddo 3348–50; Becker 1274). Similarly, PVC pipe is not susceptible to internal corrosion from sewage or other materials. Consequently, as industry witnesses testified, PVC pipe can last significantly longer than ductile iron or concrete pipe in certain end-use conditions (Yu 2121–22; DiLiddo 3348–50; Becker 1274).

104. Finally, PVC pipe reportedly has excellent flow properties. PVC pipe's generally smooth internal surface permits it to carry a greater volume of water than pipe manufactured from other materials (Yu 2188–21). For example, there was testimony that a 12-inch PVC pipe can carry as much water at a given pressure rating as a 14-inch ductile iron pipe (Yu 2118–21; Becker 1276–78). PVC's smooth interior surface reportedly also prevents the accumulation of deposits resulting from contact with water having a high mineral content (Yu 2118–21; Becker 1276–78). Traditional pipe materials, such as ductile iron, are described as to be susceptible to deposit build-up; a condition which reduces the effective diameter of the pipe, shortening its service life (Yu 2118–21; Becker 1276–78). **[29]**

105. However, there are certain characteristics of PVC pipe which make it unsuitable for a number of end-use applications. For example, PVC pipe lacks the requisite stiffness for use in above-ground irrigation systems (Yu 2154). Furthermore, its acceptability of PVC pipe has been questioned by building code and fire officials for use in drain, waste, and vent (DWV) and conduit applications because of a controversy over its behavior in a fire situation (see, *e.g.*, CX 45S; see Waggoner 3638). In addition, ductile iron pipe is considered superior to PVC pipe in municipal water pipe applications involving rocky or shifting soil conditions, or heavily traveled surfaces (Waggoner 3578–79). Finally, because PVC pipe is a relatively new product, potential purchasers are in no position to assess long-term performance properties (Yu 2121–22, 2131–33; DiLiddo 3350–51; Waggoner 3628–30, 3634–35). In this connection, there was testimony that pipe purchasers consider performance over time a significant factor in pipe selection

[22] There is evidence that PVC pipe can offer a price advantage on total-installed costs—a factor identified as an important consideration for pipe purchasers (DiLiddo 3348). For example, this would permit PVC electrical conduit producers to set the price of their product close to the price established for metal conduits and still offer the customer value in the form of lower labor costs for installation (RX 4V,W *in camera*). Similarly, a 1983 pipe industry study by Tenneco noted that PVC pipe had an installation cost advantage of $.50–$1.00 per foot over metal pipe in C–900 applications, a fact which "benefited" PVC in large diameters as costs become more competitive (CX 566E; see also CX 247A *in camera*).

because many applications envision pipe to be operational for many decades (Yu 2122; Waggoner 3630).

106. According to the record, the following constitute the major applications for PVC pipe: (1) municipal water pipe; (2) rural water pipe; (3) water service and distribution pipe; (4) sewer pipe; (5) drain waste, and vent pipe (DWV); (6) irrigation pipe; (7) communications duct; and (8) technical conduit (see CX 756Z–20).

1. Municipal water pipe

107. Municipal water pipe transports water from reservoirs, lakes, or rivers to local treatment facilities, and thence into water mains for distribution throughout the community. This segment of the pipe market is classified as "pressure pipe application," in that the water is conveyed through the pipe under pressure. As might be expected, pressure pipe applications require higher performance standards, which in turn affect design and cost (Yu 2096–99). Pipe produced for pressure applications must be engineered to withstand high internal and external pressures and to provide assurance of safety and longevity upon installation (*ibid.*).

108. Municipal water pipe is manufactured in a wide range of diameters. Large diameter pipes are needed to convey water from the reservoir to the treatment center and main lines, while smaller sizes are used to distribute water throughout local subdivisions (Yu 2114–15, 2116–15). Municipal water mains thus vary in size from 4 inches to approximately 36 inches in diameter (Yu 2115; see also Waggoner 3579–80; RX 3Z–35). Usually however, PVC municipal water pipe is sold in diameters of 12 inches or less (Yu 2115; Becker 1278; Waggoner 3580; see CX 377A-F). As noted, the smaller diameters of PVC municipal water pipe are used principally in subdivisions and housing developments (Yu 2112– **[30]** 15). The record indicates that large diameter pressure pipe represents only a [__] percentage of total PVC pipe sales (see CX 387C *in camera;* RX 165E *in camera*).

109. The municipal water pipe segment consumed approximately [__] million pounds of bulk and suspension PVC resin in 1983, accounting for [__] percent of total annual PVC resin consumption (RX 165E *in camera*).

110. PVC municipal pipe is generally purchased by the contractor chosen to install the water system (Waggoner 3574; Yu 2112). Although the contractor usually proposes the pipe material that will be used in a particular project, he is limited in this respect by the specifications drafted by the project's engineer (Waggoner 3574–75, 3584–85; Yu 2107–12). These specifications set forth the requirements of the municipality, including pipe diameters, pipe classes, installation methods, and materials that may be used on the job (Waggoner 3586).

Written specifications may designate a particular pipe material, such as ductile iron or PVC, for the entire system (Waggoner 3626). On the other hand, the specifications may call for the use of more than a single type of pipe (Waggoner 3626). Normally, municipal pipe specifications can be expected to reflect careful consideration of a number of factors such as soil conditions, terrain, and depth of the trenches to be excavated (Waggoner 3585, 3623–26). Finally, the record also suggests that specifying engineers are inclined to favor particular pipe materials based upon personal preference and prior use experience (Yu 2132–33; Waggoner 3624, 3627–29, 3631; DiLiddo 3352–53; see also CX 756–Z23).

111. The materials most commonly used in the manufacture of municipal water pipe are ductile iron, reinforced (pre-stressed) concrete, asbestos cement, and PVC (Yu 2116–17; Waggoner 3626–27, 3645–46; Becker 1275). All of these materials have distinctive performance properties which govern their selection for a particular application (see Waggoner 3617–18; Yu 2131–32; Becker 1276–78; DiLiddo 3348–53). All of the characteristics associated with PVC pipe, including flow efficiency, corrosion resistance, light weight, ease of installation, and lower installation costs come into play in the selection process.

112. For example, there was testimony that PVC municipal water pipe has smooth internal walls which resist the accumulation of deposits over time, resulting in a constant, unimpeded delivery of the water supply (Yu 2118–21; Becker 1276–77; RX 3Z–37). Thus, PVC pipe may be preferable in localities where the water to be transported has a high mineral content (see Becker 1276–77). Nevertheless, Mr. Waggoner of Griffin Pipe Products testified that competing pipe producers have devised techniques to overcome the problem of deposits (Waggoner 3577–78). He explained that ductile iron pipe manufacturers have [31] developed and for many years have utilized a cement liner which effectively insulates the interior walls of the pipe from deposit build-up (Waggoner 3577–78). In his view, therefore, the mineral deposit problem has ceased to be a significant factor (Waggoner 3577–78).

113. There was testimony that PVC municipal water pipe does not corrode in acidic, alkaline or wet soils (Becker 1274, 1276; Yu 2121–22; DiLiddo 3348–50; RX 3Z–37). Consequently, PVC pipe can be viewed as preferable to ductile iron or steel pipe in areas where soil conditions are conducive to such external corrosion (see Yu 2121–22).

114. Finally, PVC pipe was lauded in the record as frequently easier and less expensive to install than other municipal water pipe materials (Yu 2122–27; RX 3Z–36, 37). PVC pipe's light weight permits the use of hand labor in installation, thus dispensing with the necessity