From the Diesel Story Collection of the Dieselpensionierten
Winterthur, Switzerland

Sulzer Diesel Engines, Sulzer Diesel Engine Division with Successor Companies New Sulzer Diesel Ltd and Wärtsilä Switzerland Ltd until Winterthur Gas & Diesel Ltd in Winterthur

A Diesel Story written by Bruno Otto Eckert-Martin in 2015

The author eckertbruno@bluewin.ch welcomes any comments, corrections, supplements as well as your own stories for the next edition.

Content

<table>
<thead>
<tr>
<th></th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Winterthur over the Years</td>
<td>2 and 3</td>
</tr>
<tr>
<td>2. From Sulzer Bros to Sulzer Ltd</td>
<td>2</td>
</tr>
<tr>
<td>3. Begin of the Diesel Engines at Sulzer Brothers</td>
<td>5</td>
</tr>
<tr>
<td>4. Establishing the Diesel Engine Division at Sulzer Brothers</td>
<td>6</td>
</tr>
<tr>
<td>5. Sulzer Diesel Engine Types</td>
<td>4 and 6</td>
</tr>
<tr>
<td>6. Spin-off of the Diesel Division of Sulzer Ltd as Limited Company, Successor Companies</td>
<td>21</td>
</tr>
<tr>
<td>7. Wärtsilä Two Stroke Engines</td>
<td>26</td>
</tr>
<tr>
<td>8. Number of Sulzer Type Engines build or delivered until Jan 2009</td>
<td>27</td>
</tr>
<tr>
<td>9. Some Running Hours of Sulzer Engines</td>
<td>28</td>
</tr>
<tr>
<td>10. Licensing</td>
<td>28</td>
</tr>
<tr>
<td>11. Editorial</td>
<td>31</td>
</tr>
<tr>
<td>12. Sources and Acknowledgments</td>
<td>32</td>
</tr>
</tbody>
</table>
Sulzer Diesel Engines, Sulzer Diesel Division with Successor Companies New Sulzer Diesel Ltd and Wärtsilä Switzerland Ltd until Winterthur Gas & Diesel Ltd in Winterthur

Provisional 0. Edition of August 2015

Bruno Otto Eckert-Martin

For the next, the 1. Edition, the author eckertbruno@bluewin.ch welcomes any comments, corrections, supplements as well as your own stories to this provisional version. Please also refer to the Editorial on Page 31.

Content

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Winterthur over the Years</td>
<td>2 and 4</td>
</tr>
<tr>
<td>2.</td>
<td>From Sulzer Brothers to Sulzer Limited</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>Begin of the Diesel Engines at Sulzer Brothers</td>
<td>5</td>
</tr>
<tr>
<td>4.</td>
<td>Establishing the Diesel Engine Division at Sulzer Brothers</td>
<td>6</td>
</tr>
<tr>
<td>5.</td>
<td>Sulzer Diesel Engine Types</td>
<td>4 and 6</td>
</tr>
<tr>
<td>6.</td>
<td>Spin-off of the Diesel Division of Sulzer Ltd as Limited Company for Sale, Successor Companies</td>
<td>21</td>
</tr>
<tr>
<td>7.</td>
<td>Wärtsilä Two Stroke Diesel Engines</td>
<td>26</td>
</tr>
<tr>
<td>8.</td>
<td>Number of Sulzer Type Engines build or delivered until Jan 2009</td>
<td>27</td>
</tr>
</tbody>
</table>
1. Winterthur over the Years

_Around Christ Birth:_ Romans settle in Vitodurum (a celtic name, later Ober-Winterthur), the later Vicus Vitudurum and a Gallo-Roman Temple also arises in the first century. At the end of the third century, a citadel is additionally built. An inscription stone of the citadel dated 294 still exists.

~400: This settlement of Romans loses its significance by 400. The influence of the other, meanwhile grown settlement in Nieder-Winterthur, probably Alemannen, increases and develops by the 12th century from a village into a town. The village is conveniently situated in a flat area and lies at roads to Zurich, the river Rhine, lake of Constance and Töss valley and receives a market right earl. Also during this period, the separation from the parish Oberwinterthur takes place and a own parish is formed in 1180.

12th Century: Town moats, walls and towers are build

1253: First mentioning of guilds

1264: Winterthur receives the town rights from the Count Rudolf of Habsburg on 22. June 1264

1435: First townhall build

1348: First public bath, Obere Badestube (Lörlibad) and and later in 1442: Woman’s House (Bordell)

1460: Siege of Winterthur by the Swiss federal troops, but without success

1467: Habsburger pledge Winterthur to the town of Zürich and thus Winterthur becomes indirectly federal
1493 and 1519: Periodes with plagues

1524-1525: Reformation in Winterthur, counting at that time about 2500 inhabitants

1629: Musikkollegium Winterthur is founded and extended in 1875 with a Town Orchestra as well in 1879 with a Conservatorium. Today, the former Town Orchester is called Orchestra Musikkollegium Winterthur (www.musikkollegium.ch)

1775: Salomon Sulzer builds a brass foundry with lathe shop at Hirschengrab und 1830 at Holdertor, within the townwalls of Winterthur

1778: Beginning of a Chemical Industry with building a Laboratorium by Johann von Clais, Chemist and Dr med Heinrich Ziegler and Jakob Sulzer

1780~1800: Several Trading Firms are founded

1788: Trading firm Geilinger and Blum is founded, Johann Caspar Reinhart joins in 1823 as partner by marriage with the niece of Blum being the sole beneficiary, so he gains control. It developed over generations into the well known trading firm Paul Reinhart & Cie with subsideries worldwide.

1798: End of pledge to Zürich as a result of the invasion of the French troops, the town receives the full freedom back, also in respect of the political and commercial developments.

18th Century: Town of Winterthur reaches 3'000 inhabitants

1801: Commercial Society is founded by the over 60 trading firms, a basis for the successful trading

1813: Petition to town concil of Winterthur by 31 catholics for permission to celebrate Holy Mass in the town again

1825: Spinning mill and textile machine works Rieter develop out of a general goods business, founded and owned by Johann Jacob Rieter-Frey in 1795, today the Rieter Holding
### 1. Winterthur over the Years (continued)

- **1835:** Demolition of the town towers and filling up of the town moats decided.
- **1836:** Winterthur newspaper „Der Landbote“, some times later „Neue Winterthur Zeitung“, „Arbeiterzeitung“ and „Hochwacht“ are established.
- **1845:** Metal construction firm Geilinger founded.
- **1845:** First public gymnastic hall.
- **1848:** Winterthurian Jonas Furrer is elected as first Federal President of Switzerland.
- **1849:** Textile machine Works Jäggli & Cie founded.
- **~1850:** Establishment of the Unfall Winterthur (Accident Insurance) on the insistence of the growing industry, in Winterthur, transferred in 1875 into the Schweizerische Unfallversicherungs-Gesellschaft Winterthur, the later Winterthur Versicherung and today AXA Winterthur Insurance.
- **1851:** Trading firm Volkart.

### 2. From Sulzer Bros to Sulzer Ltd

- **1834:** Foundry and Works built by the two brothers, Johann Jakob Sulzer-Hirzel und Salomon Sulzer-Sulzer, outside the townwalls of Winterthur at today’s Zürcherstrasse.
- **1836:** The firm’s name Sulzer Brothers appears from middle of 1836 in letters and documents. The Sulzer fathers send their sons for „Wanderjahre“ abroad and for study of the industrial Europe. They return with new ideas and contacts and the firm starts to develop accordingly, for example:
  - **~1850:** Development of steam engines decided and Charles Brown from England in 1851 employed with the result, a first steam engine with slide control valve is introduced in 1854 and
  - **1860:** First Sulzer centrifugal pump, beside the already existing portfolio of iron foundry products, steam boilers, heating radiators, refrigeration machinery, ventilation fans, paddle steamers, tunnel building etc.

### Some Subjects of Sulzer Diesel Division on Page:

- First agreements with Diesel 6, 7
- First ships 7, 8
- First reversing diesel engine 8
- First licence agreement by Sulzer 8
- First crosshead engine, reversing 8
- Büchi supercharging 8
- First ships with two stroke crosshead engines 8, 9
- First rail locomotives 9, 10
- Rudolf Diesel is missed 9
- Büchi turbocharging, licence 10
- Direct fuel injection in Broken Hill Power Plant AUS 11
- Licence agreement with Wärtsilä-Koncernen A/B 12
- Alkaline cylinder lubricant 12
- First ship with SAD engine 12
- Rail engine contract Romania 13
- Rail engine contract with British Rail 13
- First ship with a dual fuel engine, a 7RMD90 15
- Yermak Class Icebreakers with each 9x9ZH40 15
- Licence agreement in Southkorea ROC 15
- Licence agreement in US 15
- Licence agreement in China PRC 15
- US rail locomotive market with AS 25 15

### Some Subjects of Sulzer Type Engines on Page:

#### Four Stroke

- D 6
- K, U 7
- L 8
- DV, DD, KD 9
- B, BA 11
- Rotating piston and bore cooling 11
- UV32-Basic Research (Prof Dr Holfelder) 12
- LVA 13
- A25, A20, Z40 14
- VS2/55, V65/65 15, 16
- Electronic- and electric-pneumatic remote And bridge control Z-type engines 15
- AS25, AS25H 15
- Emergency sets in nuclear power stations 15
- Nimonic exhaust valves 17
- Plasma coated X20 piston rings 19
- Developed by Sulzer Innotec 19
- ZA40, AT25 19, 20
- Free programmable computer control 20
- Two-metal Al-tin type bearings 20
- ZA40S, S20 21
- Multipulse-, respective single pipe exhaust system-turbocharging 21
- Chrome ceramic piston rings 22
- Gas operation 23
- ZA50S 23

#### Two Stroke

- Z, S, U 7
- LV, Q, MC, RV 8
- RK, DZ, DQ 9
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1855</td>
<td>First railway line at Winterthur, to Romanshorn</td>
</tr>
<tr>
<td>1860</td>
<td>Census in Winterthur: 6'523 inhabitants, 506 of it Catholics</td>
</tr>
<tr>
<td>1862</td>
<td>First bank, probably by the demand of the many trading firms and the growing industry in Winterthur is founded, the later Schweizerische Bankgesellschaft (SBG) and today, the Union Bank of Switzerland (UBS).</td>
</tr>
<tr>
<td>1862</td>
<td>First public assembly of the catholic citizens and inhabitants of Winterthur since Reformation with establishing a Catholic Parish. During this time, about 6% of the town inhabitans are catholics.</td>
</tr>
<tr>
<td>1863</td>
<td>30 of 50 larger firms in Winterthur are either engaged in cotton-trading or its treatment.</td>
</tr>
<tr>
<td>1865</td>
<td>First season of the Sommertheater (open-air theatre)</td>
</tr>
<tr>
<td>1845</td>
<td>Sulzer Bros establish a Patient Support Organisation, the later Works Health Insurance and Sulzer Health Insurance.</td>
</tr>
<tr>
<td>1870</td>
<td>Sulzer Bros establish within their works the first apprentice school of Switzerland.</td>
</tr>
<tr>
<td>1879</td>
<td>Stay of Rudolf Diesel at Sulzer Bros: he spent for health reasons a Sabbat and trainee time at their Winterthur works whilst waiting for his next examination term in Jan 1880 at the Technische Hochschule München.</td>
</tr>
<tr>
<td>1881</td>
<td>Works founded in Ludwigshafen am Rhein, Germany by Sulzer Bros for the manufacturing of the heavier steam engines for Germany and Russia (to be nearer to the marked)</td>
</tr>
<tr>
<td>1883</td>
<td>Sulzer family grave established at the Winterthurer cemetery Rosenberg in Winterthur after the death of Jakob Sulzer-Hirzel in 1883, family members died earlier are also moved into.</td>
</tr>
<tr>
<td>1887</td>
<td>Horizontal type steam engine is highly regarded at the World Exhibition in Paris. Export of Longstroke uniflow scavenged two stroke engine RTA 17, Norilsk Class Icebreakers with each 2x14ZV40 17, Owner’s engine, market prices and end of engine production in Winterthur 19, 20, MBS Diesel, Sulzer Diesel and NSD New Sulzer Diesel Ltd 21, Most powerful power plant Bauang with 21x16ZA40S 22, NSD Diesel Technology Center and Training Center 22, Most powerful Sulzer ZA40S engined Cruise Liner „Grand Princess Princess“ 23, Bankruptcy of Bremer Vulkan 23, Wärtsilä NDS Corporation 23, 24, Kill of Sulzer type S20, ZA40S and ZA50S engines 24, Powerplant Madeira Z/ZA40S 24, Wärtsilä Switzerland Ltd 25, First, last vessels with ZA50S 25, Most powerful container vessel with 14RT-flex96C 25, Last vessel with ZA40S 26, First order for dual fuel engine RT-flex50DF 26, Winterthur Gas &amp; Diesel AG 26, Wärtsilä Service Switzerland 27, T, QD, SD, ZG 10, G18, M, TAD, SAD 11, Low and high constant pressure and pulse turbocharging 11, 12, 14, 17, RS, RSAD 12, UV32-Basic Research 12, RD, ZH 13, Gas operation 14, 20, 23, Pneumatic bridge control 14, Two stage turbocharging 14, 16, RND 14, Electronic-pneumatic bridge control 15, RND-M (metric), RLA, RLB 16, Slurry tests 16, RLA, RLB 17, RND 18, RTA 18, RTA-2, RTA-C 21, Electronically controlled injection 21, RTA-T, RTA-U, RTA96C 22, Common rail injection, RT-flex without crankshaft 24, RTA82T 25, W-X35, 40, WL-X92, X62, X72, X82 RT-flex50DF 26</td>
</tr>
</tbody>
</table>

3. Begin of the Diesel Engines at Sulzer Bros

Febr 1893: Letter from Rudolf Diesel to Sulzer Bros about the...
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1868</td>
<td>First catholic parish church, St Peter and Paul is consecrated, 343 years after reformation.</td>
</tr>
<tr>
<td>1869</td>
<td>New townhall of the prosperous industrial and trade town is build under the Mayor Johann Jakob Sulzer by the famous architect Gottfried Semper in the style of the late Classicismus. Today it is regarded as one of the significant buildings of the historismus in Europe. Architect Semper has before built the Opera Dresden and the Polytechnikum Zürich.</td>
</tr>
<tr>
<td>1871</td>
<td>First catholic is elected into the town council.</td>
</tr>
<tr>
<td>1871</td>
<td>French army of General Bourbaki is interned.</td>
</tr>
<tr>
<td>1871</td>
<td>Swiss Locomotive- and Maschine Works (SLM) founded</td>
</tr>
<tr>
<td>1873</td>
<td>Water supply system complete</td>
</tr>
<tr>
<td>1874</td>
<td>Technikum Winterthur founded, today the School of Engineering and a part of the Zürich University for Applied Science (ZHaW) for study up to levels of Bachelor of Science ZFH in... and Master of Science ZFH</td>
</tr>
<tr>
<td>1893</td>
<td>Technical expectation of his in 1893 patented engine, following a visit of Wilhelm Züblin, Chief Engineer of Sulzer Bros at his place.</td>
</tr>
<tr>
<td>1893</td>
<td>16th May 1893: First agreement between Rudolf Diesel and Sulzer Brothers (Sulzer Brothers was at that time a partnership and not yet a Limited Company). It was not strictly a licence agreement but an agreement for the exclusive use of Diesel's patents in Switzerland together with an option to take up the manufacture of diesel engines later. It allowed Sulzer Brothers to have a share in the technology and also to build a research engine.</td>
</tr>
</tbody>
</table>

### 4. Establishing the Diesel Engine Division at Sulzer Brothers, Winterthur

**Early 1903:** Sulzer Brothers establishes the Diesel Engine Division (Abt 7) under Johann Jakob Sulzer-Imhoof, a partner in the firm. He is assisted by Fritz Schüeberer. Additionally, a research group was established with Arnold Lack and Walter Schenker.

### 5. Sulzer Diesel Engine Types

- **10 June 1898:** First diesel engine built by Sulzer Bros begins tests in Winterthur (one cylinder, four stroke, trunk piston, air fuel injection, bore 26cm, stroke 41cm, 20BHP at 160rpm)
- **1903:** D series, first trunk piston long stroke, four stroke engines with air fuel injection and bores 20.5-60cm, up to three cylinders with 40-200BHP, D for Diesel (1929: 1678 D, Dac and DacA with total 305'548BHP)
- **End 1903:** 1D40, first diesel engine delivered
1875: Seven railway lines at Winterthur

1896: Football club FC Winterthur founded

1900: Census in Winterthur: 22,462 inhabitants, the catholics have increased to 4,578, in the course of industrialisation with the influx of workers, partly from the catholic part of Switzerland.

1901: Swiss Locomotive- and Maschine Works builds their Wohlfahrtshaus (name today: Personal Restaurant).

1903: Electricity supply system complete

1905: School for Apprentices for Mechanical Engineering Winterthur founded (MSW)

1907: Sulzer Bros open their own work school for apprentices in a former residence of a Sulzer family at the Zürcherstr 4.

General aim: Design a program of standard engine series of four and two stroke types with one or more cylinders.

April 1903: Licence agreement between the Allgemeine Gesellschaft für Dieselmotoren AG and Sulzer Brothers giving Sulzer exclusive rights to manufacture and sell diesel engines in Switzerland, and also to export them. The licensor company known as "Die Allgemeine" was founded in 1898 by Rudolf Diesel, Maschinenfabrik Augsburg (predecessor of MAN) and Fried. Krupp.

1905: First ship with Sulzer stationary type 2D15 with 30BHP of Leeds-Liverpool Canal Co is without success for lack of manoeuvrability of propeller or gear and engine was removed to drive the company’s saw mill, beyond 1922.

1905: Second ship with Sulzer stationary type 2D20 with 45PSe at 260min⁻¹, the cargo ship "Venoge" on the Lake of Geneva is successful (bore 26cm, stroke 45cm; for Astern: Del Proposto System with generator and motor)

1906: Z series, first two stroke series, trunk piston, air fuel injection, uniflow scavenging, inlet valves in cylinder cover with 120-1000BHP~150rpm, and bores 60-76cm, Z for "Zweitakt": two stroke (1932: 147 ZA, ZF, ZPF, ZT 50, 60, 65, 66, 68, 72, 76 with total 278'970BHP; 1933: 7 DZ DZL, DZD 60, 70, 76 with total 49'200BHP; 1934-1954: 10 ZD ZD, ZDA 60, 65, 72 with total 50'470BHP)

1907: 3Z133, first two stroke stationary engine on test, valve scavenged type, 1908 installed in power station Aarau, Switzerland

1908: S series, two stroke crosshead engines with port cross scavenging, cylinder covers without valves and A-frames, with bores 18-90cm and 64-1'600BHP, cast iron design as before (1931: 621 SNo., SL, ST, SN 18-90 with total 1'178'800BHP; 1929-1937: 8 SN with 12 000BHP; 1930-1946: 36 DSD, DSDT, DSGS, MSD, KD 53, 60, 70, 72, 76 with total 224'500PSe)

1910: K series, trunk piston, four stroke, short stroke engine with air fuel injection and bores 28-64cm, up to four cyl with 120-1000BHP, 215-187rpm, 240-175g/BHPh, K for „Kurzhub": short stroke (1928: 265 K und Kac with total 92 590BHP; 1923-1928: 15 KS31 with total 2'250BHP)

1910: 6U23, first Submarine-, trunk piston, two
1911: Open-air public bath Geiselweid with basin of Olympian dimensions inaugurated

1907: Begin of expansion in Sulzer Areal Oberwinterthur

1909: Diesel-Works with large assembly areas and test beds are build, replacing older buildings in Sulzer Works Winterthur

1906: World’s first reversing two stroke diesel engine is build by Sulzer Brothers in Winterthur and presented at the World Exhibition in Milano in operation (bore 17.5cm, stroke 25cm, trunk piston, 90BHP at 375rpm)

1909: First applications of the S serie in ships, an Italian Naval tug and MS Taube on Lake of Zurich

1909: First licence agreements signed with Schweizerische Lokomotiv- und Maschinenfabrik, Winterthur, Switzerland to build Sulzer type diesel engines.

Since then, more than 100 companies in 30 countries have been granted licences at various times to build Sulzer type diesel engines

1909: Alfred Büchi, supercharging expert, is appointed as head of diesel research group. He holds a patent for a supercharged compound engine with turbine and radial compressor since 1905.

1910: World’s first two stroke crosshead engines with cross scavenging and cylinder covers without valves in service on the Italian Mailship „Romagna“

1912: One Metre-Bore 1S1000, one cylinder test engine in Winterthur (stroke 110cm, 2000BHP at 150min⁻¹), Prof Stodola from the Eidgenössischen Hochschule Zürich (ETHZ) performed extensive output tests with this engine in 1914.

1912: LV serie, trunk piston, medium speed, two stroke engines, bores 30-38cm (1912: 2 LV38, LH30 with total 1'250BHP)

1912: Q serie, compact, trunk piston, medium speed, two stroke engines, bores 23-65cm for submarine and naval applications (1944: 546 U, Q, QL, QN, M, 23-65 incl Busch-Sulzer types with total 793'320BHP)

1914-1993: L series for rail locomotives with bores 19-34cm in L- and V-versions with 6, 8, 12 and 16 cyl (for grandtotal, refer 1993)

1916: MC serie, trunk piston, medium speed, two stroke engines, bores 10-16cm (1929: 20 MC10, MC16 with total 162'870BHP)

1921-1929: Introduction of airless, direct fuel injection

1922: RV serie, simple, trunk piston, medium speed, airless injection, two stroke engines, bores 20-31cm for propulsion and stationary purposes (1929: 695 RV20, 24, 25, 27, 31
1912: Over 365 ships with diesel engines as prime movers and build by various manufactures are already in service worldwide.

1912: First stationary two stroke crosshead engines with cross scavenging and cylinder covers without valves in service with 1500 and 3750BHP respectively output (air fuel injection)

1912: First ocean-going ship with crosshead type two-stroke engines with cylinder covers without valves in service on MS „Monte Penedo“ with two 4SNo.9a, total 1700BHP at 160min⁻¹, achieving a long life until 1969! (exchangable cylinder liners, air fuel injection)

1912: World’s first diesel-engined rail locomotive with reversible direct drive with Sulzer 4LV38 in test operation with Prussian railways, but without success („Thermo-Lokomotive“)

30th Sept 1913: Rudolf Diesel is missed on board of SS Dresden on the way from Antwerp to Harwich. Later, early October, a body was found by a Dutch pilot vessel, the personal effects removed and the body committed back to the sea, as it was custom at that time. The effects belonged with total 56'990BHP)

1925: RK serie, simple, trunk piston, medium speed, two stroke engines, bores 15-38cm for propulsion and stationary purposes (1955: 1900 RKP, RKW, RKS, RKH 15, 20, 21, 25, 30, 36, 38 with total 331'526BHP)

1926: DV series, trunkpiston, four stroke engines with bores 31, 36, 38, 45, 54 und 60cm (1937: 55 DV31, 36, 38, 48 with total 21'500BHP; 1928-1929: 19 DH38 with total 10'700BHP; 1936: 48 DN and DNAc38, 45, 54, 60 with total 39'500BHP)

1927: DD and KD series, trunk piston, four stroke engine with air fuel injection and bores 22-65, up to six cyl with 130-1500BHP (1963: 1122 DDP, DDA, DDH, DDM, DGa, DDW, DDAW, DDAH 22-65 with total 385'825PSe; 1934-1946: 80 KDP, KDA, KDAc, KV 22, 29, 31, 36, 38, 48, 50, 60 with total 34'695PSe)

1929: DZ series, double acting, low speed, two stroke with bores 60-76cm and test engine 1DZ90 with bore 90cm, stroke 140cm (1933: 7 DZL, DZD 60, 70, 76 with total 49'200BHP). Dec 1935 : 2x10DZ76 with 1400BHP/cyl for refit on Italien passenger vessel Saturnia: on test bed up to 2’082/cyl at 152rpm!

1930: DQ serie, compact, trunk piston, medium speed, two stroke engines, bores 38-68cm for submarine and naval applications (1937: 6 DQD38, 42, 68 with total 18’400BHP)
1914: Sulzer Brothers, Winterthur and Sulzer Brothers, Ludwigshafen are now registered as public Limited Companies under the Holding Company, Sulzer Enterprises Ltd. Sulzer Bros Ltd realises early the importance of local agencies and subsidiaries. With the increased international export of the extended product program, new agencies and subsidiaries are continuously founded.

1918: Compagnie de Construction Mécanique Procédès Sulzer in Paris with the Work in St Denis is founded (CCM)

Until 1920: The Stationary market was the most important for Sulzer and for the application for Sulzer type engines with the 6Z300 for Harland&Wolff in Belfast being the largest (bore 76cm, 3'750BHP at 132rpm). Other installations are in Calais, Shanghai, Bucharest and Broken Hill AUS (latter plant was 55 years in service!).

1920: Sulzer Bros Ltd employs already over 600 apprentices in Winterthur.

1914: Five railcars with diesel-electric drive with Sulzer 6LV26 supplied to Prussian Railway

1925: Büchi applies for a patent for a compound internal combustion engine with turbocharger. This after extensive research at the Schweizerischen Lokomotiv- und Maschinenfabrik in Winterthur with output increase around 50%, Contrary to the patent of 1905, it is a free running turbocharger with exhaust gas driven turbine and compressor on the same shaft. The latter was already built by Brown Boveri Ltd in Baden, Switzerland.

1930: T series, trunk piston, medium speed, two stroke with bores 18-56cm, from 1946 with constant pressure turbocharging (1989: 2482 TS, TW, TD, TG, TSG, TH, TF, TPF, TA, TAD and TMPF 18, 20, 21, 23, 24, 29, 32, 36, 48, 49, 56 with total 3'794'028BHP)

1931: 743 Busch-Sulzer, various, excluding submarine engine types with total 280'310BHP (since 1916)

1932: QD serie, compact, trunk piston, medium speed, two stroke engines, bores 32-68cm for naval and submarine application (1942: 224 QDC, QDCT, QPG, QPD, VQA 32, 38, 42, 51, 54, 68 with total 481'410BHP)

1932: SD series, two stroke, crosshead engines with A-frames, port cross scavenging, cylinder covers without valves, cast iron design, bores 36-76cm, up to 12 cyl, oa SD60 and SD72 with bore 60 and 72cm, stroke 104 and 125cm, 400BHP at 135rpm and 750BHP at 131rpm, with for that time low bm of 149.2g/BHP (1969: 783 SD, SDT, SPD, MS, KD, SDS, SDH, SF 36, 40, 48, 49, 56, 58, 60, 65, 68, 72, 76 with total 3'845'840BHP)

1935: ZG serie, light, two stroke, horizontal opposed piston, medium speed engines, bores 7-17.5cm for various applications, incl lorries and tractors (1949: 1'040 ZG, ZGH, ZGR ZGX 7, 9, 14, 17.5 with total 50'200BHP)

1936-1950ies: 1SD72 research engine in Winterthur

1936: Licence agreement with Büchi-Syndikat for turbocharging to Rudolf Diesel. He was earlier reported to be in poor health and with financial problems.

1936-1950ies: 1SD72 research engine in Winterthur
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1921</td>
<td>Population of Winterthur increases following the incorporation of the surrounding villages, Oberwinterthur in the Northeast, Seen in the Southeast, Töss in the Southwest, Veltheim in the North and Wülflingen in the Northwest to 40'900 inhabitants.</td>
</tr>
<tr>
<td>1925</td>
<td>First Tail Coat Week (Frack-Woche) is introduced during the diploma time at Technikum Winterthur (today School of Engineering and part of the Zürich University of Applied Science (ZHaw), a tradition maintained still today.</td>
</tr>
<tr>
<td>1928</td>
<td>Administration and board building of Sulzer is inaugurated and receives the nickname „Olymp“, because of its prestige style.</td>
</tr>
<tr>
<td>1931</td>
<td>New assembly and test bed shop for largest diesel engines is build in Winterthur</td>
</tr>
<tr>
<td>1936</td>
<td>Two railcars named „Rotter Pfeil“, ie „Red Arrow“, of Swiss Federal Railway equipped with 6LF19 in service</td>
</tr>
<tr>
<td>1937</td>
<td>First stationary engine with direct fuel injection of type Z with six cylinders and 3200BHP is delivered as eighth engine to the Broken Hill Plant, Australia. After further extension the plant consists of 15 Sulzer engines with total 36'900BHP.</td>
</tr>
<tr>
<td>1936</td>
<td>10QDTC51, largest Q engine tested with 6900BHP (1912-1944: 776 Q engines with total 1.29 million BHP, used in 12 navies)</td>
</tr>
<tr>
<td>1937</td>
<td>Rotating piston and bore cooling patented, its father being the Sulzer employee Mr Retschi</td>
</tr>
<tr>
<td>1941</td>
<td>G18 series, two stroke engines with opposed pistons and turbocompound supercharging with bore 18cm, stroke 2x22.5cm, 280BHP at 850rpm</td>
</tr>
<tr>
<td>1942</td>
<td>M serie, trunk piston, two stroke, medium speed engines, bores 32-51cm, also for icebreakers, forerunner of ZH (1969: 265 MPF, MD, MG, MH 32, 42, 51 with total 660'960BHP)</td>
</tr>
<tr>
<td>1943</td>
<td>B and later BA with puls-turbocharging series, compact highspeed, four stroke engine for multipurpose application with bores 22, 29 and 36cm is introduced (1976: 5364 BH, BA, BW, BF, BAH, BAF, BR 22, 29, 36 with total 2'280'617BHP)</td>
</tr>
<tr>
<td>1946</td>
<td>6TAD48, world’s first constant pressure turbocharged trunk piston, two stroke engine giving a 20% boost (stroke 72cm)</td>
</tr>
<tr>
<td>1950</td>
<td>SAD series, first constant pressure, turbocharged, low speed crosshead engine</td>
</tr>
</tbody>
</table>

1947: Association for the promotion and development of a Science Museum in Switzerland
End 1940ies: The industry begins with recruiting of foreign workers, first from Northern Italy (in place of a more comprehensive automation of the industry during the time after the Second World War).

The arriving Italians change the pattern of life on Saturdays and Sundays in the town, especially around the Main Station Square, which becomes their “Piazza”. The Winterthurians have yet to learn to adjust to the pattern of life of the Italians in their town.

End 1940ies: Sulzer builds for the hired Italians a „Villaggio“ in Oberwinterthur and institutes a special care team for them.

1953: Sulzer Works Band is founded by a group of musicians, already playing for years Christmas Carols at Christmas Eve in the diesel engine assembly and test bed hall. This band is still existing under the name of Sulzer Band and still continues the original tradition of Christmas Carols under the name of Weihnachtsständchen. One of the founding members is still a active Es-clarinet player.

1951: Art Museum Oskar Reinhart am Stadtgarten opened in the Old Gymnasium, build in 1842 under architect Leonard Zeugheer and 1951 modified in to the museum. Oskar Reinhart donated already in 1940 one part of his art collection to the town Winterthur for the museum. (www.museumoskarreinhart.ch).

1954: Licence agreement with Wärtisilä-Koncernen A/B, later the licence agreement was transferred to Wärtisilä Diesel International Ltd Oy, Helsinki, Finland with works at Turku.

1956: First sea trials held with an alkaline cylinder lubricant on Sulzer engines operating with heavy fuel oil in the passenger vessel „Willem Ruys“ with eight engines of type 8TPD48 and total 32'500BHP (hydraulic engine remote control from control room). 1964 bought by Lauro Line, refurnished and renamed „Achille Lauro“ and 1994 lost after a fire (1990ies: ~250'000 running hours).

1956: First 6SAD72 Uraga-Sulzer commissioned in cargo ship MV „Dowa Maru“

First Winterthur build SAD enters with an output increase for the SAD72 to 900 BHP/cyl at 125rpm (1963: 136 SAD 60, 72 with total 722'600PSe)

1950: RS series, first low speed engine of fabricated design with tie rods, piston rod stuffing boxes and oscillating exhaust valves, bores 58 and 76cm with strokes 76 and 155cm, 520BHP at 240rpm and 1000BHP at 119rpm. The introduction of the piston rod stuffing boxes serves to positively separate the piston underside from the the crankcase to avoid contamination of the latter by combustion residues. Thus, the engine was specifically designed for operation on heavy fuel oil (1963: 132 RSD, RSG, RSAD with total 1'074'800BHP)

1955: UV32, medium speed research engine, pulse turbocharging, with rotating pistons for basic research in two and four stroke version begins development tests in Winterthur under Prof Dr Holfelder (testbed Dreispitz)

For Prof Dr Holfelder’s activities at Sulzer, refer to www.vdmw.ch > Dieselgeschichten

1956: RSAD76, first Sulzer pulse turbocharged low speed engine, bore 76cm, stroke 155cm, 1300BHP/cyl at 119rpm (1950-1963: 132 RS, RSD, RSG, RSAD with total 1'074'800BHP)
1957: Kistler Instruments Ltd founded

1956: Sulzer inaugurates their second Wohlfahrtshaus, in the works of Oberwinterthur (name today: Personal Restaurant). The first Wohlfahrtshaus, in the works Winterthur, was already build decades earlier.

1957: Romania buys five locomotives with 12LDA28 together with the right to build these locomotives with this engine type for a lump sum. In the 2000ies it turns out, that over 5'246 LDA28 with over 9'794'800BHP were build by UCM Resita in Romania for various applications, though mainly for traction in Poland, China, North Korea, Bulgaria and Romania itself.

1957: RD series, first loop-scavenged, pulse charged, modern low speed engine of refined fabricated design with tie rods, piston rod stuffing boxes and rotary exhaust valves, bores 44-90cm, ao RD76 and RD90 with bores 76 and 90cm, strokes 155 and 155cm, 1700BHP/cyl at 122rpm and 2300BHP/cyl at 122rpm, up to 12 cyl. 1959: first 6RD76 with 7800BHP at 119rpm is on test bed in Winterthur. The from the begin successfull RD series is one of the main reasons for the marked increase of the world market share of Sulzer type engines (1987: 2100 RD, RF 44, 56, 68, 76, 90 with total 22'546'550BHP)

1957: LDA28 are chosen by British Railway for part of the over 3000 new main line locos. The Sulzer type engines are mainly build under a joint venture between Sulzer UK Ltd, London and Armstrong-Vickers, Barrow in Furness (up to 1968: 1397 LDA28 with 6,8 or 12cyl).

Additionally the most powerfull loco Kestrel with a Sulzer 16LVA24 with 4000BHP is build, tested and sold in 1971 to UdSSR.

1957: Schweizerische Lokomotiv- und Maschinenfabrik, Winterthur (SLM), founded 1871, is bought by Sulzer Bros Ltd.


1960: LVA24 serie for rail locomotives with bore 24cm in V-version (1972: 112 LVA24 with total 338'000BHP)

1962: ZH40, first medium speed engine of two stroke type with fully bore-cooled components around combustion space, pulse turbocharging, reversible, L-version, for icebreakers; also ZV30 (1982: 100 Z40, ZH40,
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1969</td>
<td>Foundation formed for the promotion of a Science Museum of Switzerland</td>
</tr>
<tr>
<td>1969</td>
<td>Sulzer Bros Ltd holds 50% of shares of Escher Wyss-Group, Zürich with full take over in 1969.</td>
</tr>
<tr>
<td>1966</td>
<td>Sulzer Bros Ltd builds the first skyscraper in Winterthur, receiving the nickname „Faulhorn“, a name of a Swiss mountain, ie „Lazy Horn“.</td>
</tr>
<tr>
<td>1968</td>
<td>Sulzer Bros Ltd with new organisation and introduction of holding groups</td>
</tr>
<tr>
<td>1969</td>
<td>Sulzer Ltd buys Maschinenfabrik Burckhardt, Bale, Switzerland</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1966</td>
<td>Sulzer Bros Ltd holds 50% of shares of Escher Wyss-Group, Zürich with full take over in 1969.</td>
</tr>
<tr>
<td>~1964</td>
<td>1RSA76 research engine with gas operation in Winterthur</td>
</tr>
<tr>
<td>~1965</td>
<td>Pneumatic remote control, respectively bridge control is introduced for the two stroke engines</td>
</tr>
<tr>
<td>~1965</td>
<td>Two-stage turbocharging on extensive test bed trials on a 5RD68 engine in comparison to pulse and constant pressure turbocharging in Winterthur</td>
</tr>
<tr>
<td>1966</td>
<td>Sulzer Bros Ltd builds the first skyscraper in Winterthur, receiving the nickname „Faulhorn“, a name of a Swiss mountain, ie „Lazy Horn“.</td>
</tr>
<tr>
<td>1968</td>
<td>Sulzer Bros Ltd with new organisation and introduction of holding groups</td>
</tr>
<tr>
<td>1969</td>
<td>Sulzer Ltd buys Maschinenfabrik Burckhardt, Bale, Switzerland</td>
</tr>
<tr>
<td>1964</td>
<td>1RSA76 research engine with gas operation in Winterthur</td>
</tr>
<tr>
<td>~1965</td>
<td>Pneumatic remote control, respectively bridge control is introduced for the two stroke engines</td>
</tr>
<tr>
<td>~1965</td>
<td>Two-stage turbocharging on extensive test bed trials on a 5RD68 engine in comparison to pulse and constant pressure turbocharging in Winterthur</td>
</tr>
<tr>
<td>1967</td>
<td>RND series with bore cooled cylinder liners and constant pressure turbocharging with bores 68-105cm, stroke 125-180cm, 1650BHP/cyl at 150rpm up to 4000BHP/cyl at 108rpm (1988: 2180 RND, RNF, RNMD 68, 76, 90, 105 with total 31′918′300BHP).</td>
</tr>
<tr>
<td>1968</td>
<td>12LVA24, several traction engines were equipped with rotating pistons</td>
</tr>
<tr>
<td>1970</td>
<td>Z40 series, first modern medium speed, four stroke engines with fully bore cooled components around the combustion chamber, pulse turbocharging, for HFO operation up to 380cSt/50°C-3500secs RW1, bore 40cm, ZV30 with total 601′100BHP)</td>
</tr>
</tbody>
</table>
1973: Winterthur establishes a pedestrian zone in the city

1974: Public indoor swimming pool is opened adjacent to the open-air pool Geiselweid, the latter being the oldest one in Switzerland

1973: Sulzer Ltd has the opportunity to buy the Diesel Engine Works of Burmeister & Wain, Denmark out of the bankrupt Burmeister & Wain Shipyard Holding. However, Sulzer Ltd declines. It was said, Japan could start there own two stroke engine development, considering the strong marked lead of Sulzer and B&W together. However, MAN takes the chance and MAN-B&W will become some years later our main competitor.

Retrospect of Sulzer's entry into US rail locomotive market: This entry, with considerable personnel and capital investment involved, was at the end without success.

1973: World's first ship with dual-fuel low-speed engine LNG carrier 'Venator' is Sulzer engined, with 7RNMD90

1974: First of three Yermak-Class Icebreakers for Morflot UdSSR with each nine 9ZH40 with total 57'800BHP is delivered (last: 1976). After the end of the UdSSR, they were modified and cruised as expedition vessels ao in the Antarktis.

1975: First licence agreement in Southkorea ROC
1976: First licence agreement in US
1978: First licencee agreement in China PRC

1978: Entry in the US rail locomotive market with the installation of AS25 by Morrison & Knudsen, Boise in 15 refurnished locs:
Southern Pacific Locs Nr. 7030-70334, each 12AVS25 Sulzer:

stroke 48cm, 750BHP/550kW at 560-600min⁻¹, L-, V- and reversible versions, 6-16 cyl (1999: 901 ZVB40, ZL40, ZV40, ZL40/48, ZV40/48 with total 6'577'350BHP).

Initially this Z engine type was equipped with an electronical-pneumatical remote control, but later changed to electrical-pneumatical remote control, as for all future Z-type engines.

1971: V52/55 series, MAN design, time limited cooperation (1982: 2 V52/55 mit total 25'320PSe, licencse build)

~1973: Electronic-pneumatic remote-, respectively bridge control introduced for low speed two stroke engines


~1975: Certificate for ZL40 and ZV40 types for emergency sets in nuclear power stations received after modifications accordingly and successful special endurance tests:

1975-1993: 102 engines of ZL40 and ZV40 type ordered at our licencees for emergency sets in Nuclear Power Stations, oa:
For various reasons: installing of modern engines in refurnished locs with given systems far from optimal, initial thermal but solved problems from exhaust intake in tunnels in the Cascade mountains, US competition (monopol) and union against us, suspected sabotage, ie contamination of lub oil, new oil filter cleaning concept and different overhaul concept compared wit GE's Power Pack with connecting rod, piston, cylinder liner and -cover either replaced by refurnished or new ones. But the final was the fire in the control stand of one loc on a ramp. The train of SP was not able to start anymore with three locs only and had to be disengaged downwards. This on the eve of signing a contract with a railway company for 50 AT25 engines for new locs! It was also for the author a moving night, not only because of the disappointing incident, but also because of the calls from and with General Directors of Sulzer. Our sales delegation was put off by SP and we sat on several engines ordered in expectation at our licencee. However, later they could be sold ex stock for urgent replacement of problem engines in supply vessel in the Caspian.

<table>
<thead>
<tr>
<th>Location</th>
<th>Type</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comecon</td>
<td>12ZV40</td>
<td>65</td>
<td>1975-1993</td>
</tr>
<tr>
<td></td>
<td>6ZL40</td>
<td>30, total 95</td>
<td>1980-1985</td>
</tr>
<tr>
<td>EDF France</td>
<td>16ZV40</td>
<td>4</td>
<td>1987-1989</td>
</tr>
<tr>
<td>Japan</td>
<td>14ZV40</td>
<td>2</td>
<td>1987</td>
</tr>
<tr>
<td></td>
<td>16ZV40</td>
<td>1, total 3</td>
<td>1987</td>
</tr>
<tr>
<td></td>
<td>1975: 12V65/65, largest medium speed four stroke engine with rotating pistons with 21'600BHP on testbed in Winterthur, 1800BHP/400rpm under Sulzer-MAN time limited cooperation until 1979 (1973-1975: 1 V65/65 with 21'600PSe; L-version with standard pistons tested at MAN, Augsburg)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1975: Further trials with constant pressure and two-stage turbocharging on three cylinders of a RND90 engine, up to BMEP of 17 bar</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1976: RND-M series (all dimensions metric) with new combustion chamber, modified injection system, a accumulator-type cylinder lubricator system and re-designed piston as well as bore cooled cylinder covers were introduced. The latter in addition to the since the RND series already bore cooled cylinder liners with bores 68-90cm, stroke 125-155cm, 1900BHP/cyl at 150rpm up to 3350BHP at 122rpm (1990: 603 RN..M RND..M, RNF..M 68, 76, 90 with total 10'346'360PSe).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
|                | 1978: One cylinder 1RSA76 experimental engine in Winterthur modified for tests with coal-water slurry (50/50%) following the second oil crisis (~1978-1980), co-financed by the US Departement of Energy (DoE with the coal-slurry delivered by a US firm. Results:

1978-1980 (140'000 US miles), today privatly owned

M&K Leasing Loc Nr. 5001 with 6ASL25 Sulzer: 1979-2006 (27 years!), last at Morristown and Erie Railroad, following lack of spares, engine taken out

Santa Fe Locs Nr 5496-98, each 16AVS25 Sulzer and Loc 5499, each 16AVS25 HCP: 1980-1985 (100'000-120'000 US miles), Engines taken out, bought by yard/shipowner and installed in Mississipi pushboats with each 2x16ASV25

Union Pacific Locs Nr 60, 64, 65, each 16AVS25 Sulzer and Locs Nr 61-63, each 16AVS25 HCP: 1981-1983 (140'000-200'000 US miles), Locs until 1987 at UP, than bought by loc dealer and sold in 1997 to scrap dealer, loks scrapped, engine parts sold as spares

1978: One cylinder 1RSA76 experimental engine in Winterthur modified for tests with coal-water slurry (50/50%) following the second oil crisis (~1978-1980), co-financed by the US Departement of Energy (DoE with the coal-slurry delivered by a US firm. Results:

1975: 12V65/65, largest medium speed four stroke engine with rotating pistons with 21'600BHP on testbed in Winterthur, 1800BHP/400rpm under Sulzer-MAN time limited cooperation until 1979 (1973-1975: 1 V65/65 with 21'600PSe; L-version with standard pistons tested at MAN, Augsburg)

1975: Further trials with constant pressure and two-stage turbocharging on three cylinders of a RND90 engine, up to BMEP of 17 bar

1976: RND-M series (all dimensions metric) with new combustion chamber, modified injection system, a accumulator-type cylinder lubricator system and re-designed piston as well as bore cooled cylinder covers were introduced. The latter in addition to the since the RND series already bore cooled cylinder liners with bores 68-90cm, stroke 125-155cm, 1900BHP/cyl at 150rpm up to 3350BHP at 122rpm (1990: 603 RN..M RND..M, RNF..M 68, 76, 90 with total 10'346'360PSe).

1978: One cylinder 1RSA76 experimental engine in Winterthur modified for tests with coal-water slurry (50/50%) following the second oil crisis (~1978-1980), co-financed by the US Departement of Energy (DoE with the coal-slurry delivered by a US firm. Results:
1979: Development of a longstroke, uniflow scavenged two stroke engine serie under secret general staff planning is decided, the later RTA serie.

1978: RLA and later RLB series, still cross scavenged, but fully bore-cooled components around combustion space applied, a design feature for all future Sulzer type low speed engines, bores 56-90cm, stroke 115-190cm, 1340BHP/cyl at 170rpm up to 3600BHP/cyl at 98rpm followed by RLB series with 1500BHP at 170rpm up to 4000BHP at 102rpm (1997: 477 RLA, RLB 56, 66, 76, 90 engines total 7'089'790BHP).

However, the thermal and other problems experienced with the RLB-series initiated the decline of the world market share of Sulzer type low speed engines. The opportunity was missed, to change already and in good time to the uniflow scavenged two stroke engine instead of the RLB. The conservative group within the Diesel Division was still too strong at that time.

1980: Nimonic 80a exhaust valves without armouring together with rotating devices are introduced on Z40 and on A/AS25 operating on HFO to replace the original version of exhaust valves with Stellite and additional Nova armouring. This decision follows an extensive comparision and test programm with Nimonic exhaust valves armoured with Alloy or Colmonoy 6 and Nimonic 80a unarmoured.
100% US content. These main engines are manufactured under subcontract by Allis-Chalmers, Milwaukee, WI. Sulzer NY is fully responsible for quality and deadlines. This solution of subcontracting is chosen because the Sulzer licensee in US, Westinghouse in Sunnyvale, CA was unable to obtain the Emission Permit to run the engines on their test bed. The three APL vessels are built by Avondale Shipyards, Inc, New Orleans LA. These three 12RND90Ms remain the first and only large low speed engines ever built in the US. In 1982 the US Government under President Reagan canceled the so-called Construction Differential Subsidiary Program but changed the Jones Act to allow up to 40% of the vessels value to be imported. This certainly ended the building of large propulsion plants in the US. Therefore these three vessels “C9” are the only ones build of their class. They are still successfully operating between the US West coast, Hawaii and Guam for Matson Navigation Co and maintained by ex Sulzer Service Engineers.

1981: Sulzer Ltd is restructured in Finland until Wärtsilä decided to sign a licencee agreement for the Z40 type, additionally to the PC from Pielstick. For this task, a special representative was delegated to Finland by the Diesel Div. On the other hand, our technical delegation had also to convince Morflot in Moscow. Some luck was also with us, the Pielstick delegation, sure the PC to be chosen, behaved like an elephant in a porcelain shop in Moscow.

All Sulzer type engines will benefit from the considerably longer overhaul intervals as a result.

Memory: The original version of exhaust valves with Stellite and additional Nova armouring performed very well with overhaul intervals of up to 12,000 running hours until a change of cracking method following a fuel oil crisis took place. Thus, the lifetime of an exhaust valve of a Z40 engine was sometimes reduced to some hundred running hours only. On my desk I found from time to time burned exhaust valves returned by clients with a Swiss flag on it.... Being in charge of the Technical Service for Four Stroke Engines, I had no alternative but to recommend to the clients to apply fuel additives modifying the melting characteristic of the ashes until we found the already mentioned solution for the exhaust valves.

1980: R2 engine with bore 56cm, as forerunner of our uniflow scavenged engine is run in Winterthur in secrecy behind high walls. The actual development and design of the engine series, designated as RTA is carried out in secret as a General Staff Exercise, including technical articles published to mislead. The competitor is thus caught in the progress of developing an engine serie with not competitive parameters when we introduced the RTA series.

1981: RTA-8 series introduction with the long stroke, uniflow scavenged two stroke engine concept, constant pressure turbocharging,
1982: Swiss Science Centre Technorama inaugurated (www.technorama.ch)

1982: Maschinenfabrik Rüti taken over (Textile Machine Works)

1984: 150 Year Jubilee of Sulzer Ltd

1887: Swiss financier Tito Tettamanti (TT) realises that the Sulzer shares value does not reflect the cash level of milliards (US: billions) of Sulzer Ltd and starts together with friends to buy name shares up to a quota of 35%. Owing to the Vinikulierung Rules, the board must, but did not approve this quota. The investor is interested in a fast financial result, but Sulzer on one hand is not interested in selling profitable divisions just for profit reason and on the other hand wants to remain independent. Negotiations failed, both offers, a membership in the board or a buying back of the shares was rejected by TT. Eventually a „white ritter“ is found and TT can sell his shares to the financier Werner K Rey, apparently with profit. During this attack time, the share rate

### 1984: Most powerful Sulzer Z40 type engined power plant in Europe, Vitoria in Madeira, Portugal with six 16ZV40 CCM with total 49’700kW-71’200BHP (first engine commissioned: 1979)

1980ies: Marked prices of diesel engines start to lower with the increasing number of engine builders in Asia, especially in Southkorea ROC. Eventually this market price falls below ours of the working place Switzerland. However to maintain the production know-how, the engine production in Winterthur is continued until the sale losses were felt to heavy and the production in Winterthur was as a consequence, ended. In the view of this decision, a know-how group is being formed to be prepared for the time after in respect of our licencees and our own personal.

With the increasing shipyards in Southkorea ROC and later in China PRC together with the introduction of serie type vessels, the personal relationship between ship owners or mangement of shipping companies and the engine builders is also subject to changes. Main engines were before mainly build into a vessel with exhaust valves of Nimonic-technology with bores 38-84cm, stroke 110-240cm, 930BHP/cyl at 196rpm up to 4760BHP/cyl at 95rpm (2000: 765 RTA 38, 48, 58, 68, 78, 84 with total 13’065’780BHP).

With the introduction of the RTA-8, beginning with the RTA58, our market share increases until the competitor introduces his own longstroker, but with a higher stroke to bore relation with the resultant lower specific fuel consumption. Now we are asked, on one hand with the solutions for the unavoidable teething problems of a new engine series and on the other hand with the design of a second RTA series with a higher stroke to bore relation.

Irrony of company history: a higher stroke to bore relation for the RTA-8 is initially proposed, but a more conservative in-house group choose differently.

1980er: Plasma coated piston rings of X20 formula are developed by Sulzer Innotec and tested in Z40 engines. Following the low wear results on cylinder liners and rings itself with longer overhaul intervals, they are introduced.

1981: ZA40 series, medium speed four-stroke engines with fully bore-cooled components around the combustion chamber, pulse turbocharging, for HFO operation up to 380cSt/50 C-3500secs RW1, 640-660kW at 580-600 min⁻¹, L-, V- and reversable version, 6-18 cyl (1988: 28 ZAL40, ZAV40 with total 201’840Pse)
increased from around CHF 3000.- to a day peak of CHF 7300.-. Members of the Sulzer-family take this unique opportunity and sell their shares with good profit.

1980ties: Sulzer Ltd plans to build in the unused Winterthur works a new town section with the name Winti-Nova. However, the necessary destruction and new building receive little support in the public debates and the idea is dropped. Therafter, Sulzer Ltd invites architects for proposals for the use of the areal. The french star-architect Jean Nouvel wins the competition with his project Megalou. However it failed for financial and partly recession reasons. A period of intermediate use follows. But after all, the works areas in Winterthur and Oberwinterthur are also finally sold. The buyers are ao, the town of Winterthur and a construction firm. Old buildings are refurbished and extended and new ones build with a mix for living, office and other purposes, including faculties of the Zürich University for Applied Science (ZHaW). Further planning and building is still going on.

1982: AT25 series, modern highspeed four stroke engines, pulse turbocharging for HFO-operation as main engines, with bore 25cm and 27.5cm for operation on gas, in L- und V-Versionen with max 300BHP/cyl at 1000rpm (2005: 659 ATL, ATV, ATL..H, ATL25R, ATL27.5GL with total 1'203'928BH)

as owner’s supply. However, with the introduction of the serial type vessels with the already given main engine type, this pattern changed. Should a client have wished to change to another brand, considerable additional charges would be involved. Thus shipping companies buy their ships more and more with the given main engines. As a result, it becomes very important for a engine builder to be in closed contact with the shipyard to learn early enough about any projects of a new serie type vessel to have his engine chosen. We were not always sucessfull in this respect.

1986: Last marine diesel engine is build in Winterthur and delivered to a shipyard in Kiel, Germany.

1988: Last acceptance test in Winterthur and delivery of a earlier cancelled stationary engine

1989: Last vessel with Wärtsilä build ZV40 is delivered (MS Stepan Krasheninikov-2x12ZV40)

1982: Free programmable computer control at a reversable medium speed 6ZL40 engine on research testbed in Winterthur in cooperation with Siemens

1983: Two-metal Al-tin type 212 bearings are introduced on the modern Sulzer four stroke engines to replace all previous versions of main- and bottom end bearings of type Rillenlager 336, tri-metal with overlay 332/333, bronze with overlay 303 and white metal 314/315. The spherical top end bearing type of bronze with flash 328 on the Z type engines is however continued. Sulzer initiated the tests with the two-metal Al-tin bearings against the initial resistance of the some of the established bearing manufactures. However the results proved the expectations, including the emrgency running behaviour. Incidentally, Al type bearings were already applied on some L engines as far back as 1952.

1984: First tests with high pressure gas injection on one cylinder of a RTA84 at Diesel United with good results. This technology is today applied by MAN-B&W on their two stroke engines, whereas Wärtsilä has preferred low pressure injection.
End of 1980ies: What was announced by Sulzer Ltd as rebuilding of the Heavy Industry into a High Tech-Holding, results effectively into the „Sale of the Sulzer Family Silver“ by spin-off, selling or management buy-out of the individual divisions. Also property and land is sold until the remaining part of Sulzer Ltd houses partly in leased buildings and consists only of a few division, ao Chemtech, Pumps, Innotec and Services.


1st July 1989: Spin-off of diesel engine division as MBS Diesel Engines Ltd. For this (and other following companies), the company name was registered in three languages, German, English and French, with equal status. The intention is to sell this company to MAN-B&W, Augsburg.

1st March 1990: MBS Diesel Engines Ltd is renamed to Sulzer Diesel Ltd. Following the intervention of several German Shipowners, the German Bundeskartellamt objects the take over and Sulzer Ltd has to look for another buyer.

15th Nov 1990: Sulzer Diesel Ltd is renamed to New Sulzer Diesel Ltd (NSD), when shares are sold by Sulzer Ltd to the shipyard groups Bremer Vulkan Verbund AG, Germany and Fincantieri, Italy (42 per cent each) and NSD management (six per cent), with Sulzer Brothers keeping ten per cent.

1984: RTA-2 series with larger stroke/bore relation, bores 52-84cm, strokes 180-290cm, 1750BHP/cyl at 122rpm up to 5070BHP/cyl at 81rpm (2008:106 RTA72 with total 2’36080BHP; Jan 2009: at 539 RTA52, 62, 84M with total 8’965’790BHP)

1985: ZA40S series, first long stroke medium speed engine, multi pulse, respectively single pipe exhaust system turbocharging, for HFO operation up to 460cSt/50 C-4500secs RW1 (980BHP/720kW/cyl at 510/514min \(^{-1}\) (tests in DPP Panay up to 1090BHP/800kW), L- and V-version, 6-18 cyl (2007: 894 ZAL40S, ZAV40S and ZA40SG with total 11’023’760BHP)

Multi pulse, respectively single pipe exhaust systems are defined by a diameter of the single exhaust pipe smaller than the cylinder bore so pulsation and the kinetic energy of the exhaust gases remain.

1988: S20 series, first long stroke highspeed engines, multi pulse, respective single pipe exhaust system turbocharging, for HFO-operation up to 700cSt/50 C, 115-160kW at 720-1000min \(^{-1}\), L-version, 6-9 cyl, introduced at SMM, Hamburg (2006: at 687 S20 and S20U with total 1’036’848BHP)

1988: RTA84C with bore 84cm, stroke 240cm, 5510BHP/cyl at 102rpm, C for container (2004: 206 RTA84C with total 10’368’400BHP)

1990: 4RTX54 „First Technology Demonstrator“ and world’s first electronically-
1991: Winterthorian Prof Dr Richard Ernst receives the Nobel prize for Chemistry

1993: Fotomuseum opened, supported by the Foto Foundation Switzerland (www.fotomuseum.ch und www.fotostiftung.ch)

1993: Sulzer Ltd closes their Large Component Foundry Works and as a consequence, New Sulzer Diesel Ltd with its licensees had to build up alternative suppliers. However in the meantime, they ordered as many engine blocks as possible and kept the foundry going for quite some time. The author attended with the Sulzer Band the farewell ceremony of the foundry and has never experienced before such introverted and sad faces as such of the present founders.

1995: Sulzer Ltd sells their shares held at New Sulzer Diesel Ltd to Bremer Vulkan and Fincantieri.

1990: The diesel engine activities of Compagnie de Construction Mécanique Procédés Sulzer, Mantes la Jolie (CCM) are continued by New Sulzer Diesel France (NSFR) as well as the existing licensee agreement. NSFR with their own personal rents works and offices from CCM, but owns the production facilities. CCM and NSDF benefit from the French soft loans and are quite successful in the power station market, especially with the ZA40S type and in China.

1991: RTA84T and later RT-flex84T with bore 84cm, stroke 315cm, 6-9cyl, (D) 4200kW/cyl at 76rpm, T for tanker and bulker (Jan 2009: at 161 RTA84T and RT-flex84T with total 6216'115BHP)

1992: RTA-U series with bores 52-72cm, stroke 180cm-2120BHP/cyl at 135rpm up to, U for universal (Jan 2009: at 420 RTU..U 52, 62, 72 with total 8588'920BHP)

1993: Grandtotal of all four stroke L series: 8015 LD LDA, LTD, LHD, LF, LFA, LAH, LV 19-34 with total 13'660'285BHP, mainly for rail locomotives, but also for other non-traction applications, such as stationary, marine auxiliary and marine propulsion.

1994: Most powerful power plant Bauang, Philippines equipped with twentyone Sulzer 16ZA40S is commissioned, eleven Hitachi, six GMT and four CCM build with total 227'000kW-329'280BHP (ordered: 1993).

1994: RTA96C and later RT-flex96C with bore 96cm, stroke 250cm, 6-14 cyl (B)5720kW /cyl at 102rpm (Jan 2009: at 409 RTA96C, RT-flex96C with total 32'611'240BHP)

~1994: Chrome ceramic piston rings are developed under a Goverment of Germany scheme by German piston ring manufactures and larger diameter sizes are long term tested in Z type engines and become, following very low wear results on cylinder liners and rings itself, standard as top piston ring. Some years later, they are applied in Sulzer low speed controlled multi-cylinder uniflow two-stroke engine in Winterthur. Basis is the existing R2, modified to electronically controlled injection (SUSIG) and bore reduced to 54cm to take higher firing pressures (stroke 215cm).

1995: New Sulzer Diesel Ltd inaugurates modern Diesel Technology Center, including a Diesel Training Centre in Oberwinterthur. An additional NSD family day is held with inviting the Sulzer Band.

1990: The diesel engine activities of Compagnie de Construction Mécanique Procédés Sulzer, Mantes la Jolie (CCM) are continued by New Sulzer Diesel France (NSFR) as well as the existing licensee agreement. NSFR with their own personal rents works and offices from CCM, but owns the production facilities. CCM and NSDF benefit from the French soft loans and are quite successful in the power station market, especially with the ZA40S type and in China.

1991: RTA84T and later RT-flex84T with bore 84cm, stroke 315cm, 6-9cyl, (D) 4200kW/cyl at 76rpm, T for tanker and bulker (Jan 2009: at 161 RTA84T and RT-flex84T with total 6216'115BHP)

1992: RTA-U series with bores 52-72cm, stroke 180cm-2120BHP/cyl at 135rpm up to,, U for universal (Jan 2009: at 420 RTU..U 52, 62, 72 with total 8588'920BHP)

1993: Grandtotal of all four stroke L series: 8015 LD LDA, LTD, LHD, LF, LFA, LAH, LV 19-34 with total 13'660'285BHP, mainly for rail locomotives, but also for other non-traction applications, such as stationary, marine auxiliary and marine propulsion.

1994: RTA96C and later RT-flex96C with bore 96cm, stroke 250cm, 6-14 cyl (B)5720kW /cyl at 102rpm (Jan 2009: at 409 RTA96C, RT-flex96C with total 32'611'240BHP)

~1994: Chrome ceramic piston rings are developed under a Goverment of Germany scheme by German piston ring manufactures and larger diameter sizes are long term tested in Z type engines and become, following very low wear results on cylinder liners and rings itself, standard as top piston ring. Some years later, they are applied in Sulzer low speed controlled multi-cylinder uniflow two-stroke engine in Winterthur. Basis is the existing R2, modified to electronically controlled injection (SUSIG) and bore reduced to 54cm to take higher firing pressures (stroke 215cm).
1997: Association for city tours with woman subjects is founded. Other city tours organisations have already existed for many years.

1997: Sulzer Ltd forms the Hexis Division for the development of fuel cell heating electricity modules.

1997: The Sulzer Patient Support Organisation founded in 1845 developed over the years into a full-swing Sulzer Health Insurance Ltd for their employees with family members and also later for several of their spin-off companies. The latter is the reason for changing the name to Provita Health Insurance Ltd, Winterthur, already before fully independent from Sulzer Ltd.

1994: Research with direct gas high pressure injection at a 2ZA40SG Dual Fuel engine at Grandi Motori Trieste (GMT) with gas pressure 365bar. Despite good results, it is not introduced in serie engines, as gas engines with low pressure injection with better emissions were round the corner (lean burn combustion). Additionally, the energy demand for high pressure injection at 365bar reduces the overall efficiency considerably.

31st Dec 1995: Shares held by the management of NSD are sold to Bremer Vulkan and Fincantieri, at pari shareholding is maintained.

1996: Most powerfull Sulzer ZA40S type engined Cruise Liner „Grand Princess“-108’806 GRT of P&O Cruises is delivered (six GMT 16ZA40S with total 94’080BHP).

3rd April 1997: Fincantieri sells its Diesel Engine Works in Trieste, Italy (with 500’000m$^2$ largest in Europe) together with New Sulzer Diesel Ltd as „Pawn Sacrifice“ („Bauernopfer“) to Metra Corporation, Finland which will merge it with Wärtsilä Diesel Oy to create Wärtsilä NSD Corporation.

The buyer was interested in the increase of manufacturing capacity but also expected by the purchase of NSD on one hand an increase of its status and on the other hand a similiar world share engines too.

1995: ZA50S series, long stroke medium speed engine, multi pulse, respective single pipe exhaust system turbocharging, for HFO-operation up to 460cSt/50 C-4500secs RW1, 1360BHP/1200kW at 450min$^{-1}$, L-version (2000: 7 ZAL50S with total 97’800BHP)

31st Dec 1995: Shares held by the management of NSD are sold to Bremer Vulkan and Fincantieri, at pari shareholding is maintained.

1996: Most powerfull Sulzer ZA40S type engined Cruise Liner „Grand Princess“-108’806 GRT of P&O Cruises is delivered (six GMT 16ZA40S with total 94’080BHP).

31st Dec 1995: Shares held by the management of NSD are sold to Bremer Vulkan and Fincantieri, at pari shareholding is maintained.

1996: Most powerfull Sulzer ZA40S type engined Cruise Liner „Grand Princess“-108’806 GRT of P&O Cruises is delivered (six GMT 16ZA40S with total 94’080BHP).

3rd April 1997: Fincantieri sells its Diesel Engine Works in Trieste, Italy (with 500’000m$^2$ largest in Europe) together with New Sulzer Diesel Ltd as „Pawn Sacrifice“ („Bauernopfer“) to Metra Corporation, Finland which will merge it with Wärtsilä Diesel Oy to create Wärtsilä NSD Corporation.

The buyer was interested in the increase of manufacturing capacity but also expected by the purchase of NSD on one hand an increase of its status and on the other hand a similiar world share engines too.

1994: Research with direct gas high pressure injection at a 2ZA40SG Dual Fuel engine at Grandi Motori Trieste (GMT) with gas pressure 365bar. Despite good results, it is not introduced in serie engines, as gas engines with low pressure injection with better emissions were round the corner (lean burn combustion). Additionally, the energy demand for high pressure injection at 365bar reduces the overall efficiency considerably.

1995: ZA50S series, long stroke medium speed engine, multi pulse, respective single pipe exhaust system turbocharging, for HFO-operation up to 460cSt/50 C-4500secs RW1, 1360BHP/1200kW at 450min$^{-1}$, L-version (2000: 7 ZAL50S with total 97’800BHP)

1995: 4RTA58T „Second Technology Demonstrator“ commissioned in new NSD Technology Center in Oberwinterthur as well as component test stands for 2- and 4 stroke injection and 2 stroke exhaust valves (engine build by DMR Rostock, bore 58cm and stroke 241.6cm)

1995: RTA-T and later RT-flex with bores 48 and 58cm, strokes 200 and 241.6cm, (D)1455kW/cyl at 127rpm and (E)2350kW/cyl at 105rpm (E) (Jan 2009: at 447 RTA..T, RT-flex..T 48, 58 with total 6’211’835BHP)

1997: Sulzer Ltd forms the Hexis Division for the development of fuel cell heating electricity modules.

1997: The Sulzer Patient Support Organisation founded in 1845 developed over the years into a full-swing Sulzer Health Insurance Ltd for their employees with family members and also later for several of their spin-off companies. The latter is the reason for changing the name to Provita Health Insurance Ltd, Winterthur, already before fully independent from Sulzer Ltd.
2002: Technology Parc in former Sulzer-Areal is inaugurated

2002: Public Skating and Ice Hockey Hall is opened

2004: Culture Foundation with social archives and library is initiated by former Mayor Urs Widmer and Peter Hauser

2005: Winterthurer Diesel Pensioners meet at their first yearly gathering


2008: Club of Rome moves to Winterthur

2008: Winterthur with over 100'900 inhabitants becomes lastingly the 6th largest town of Switzerland. The town counts over 56'000 working places.

2011: Verein Diesel Motoren Winterthur is founded (www.vdmw.ch)

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>Technology Parc in former Sulzer-Areal is inaugurated</td>
</tr>
<tr>
<td>2002</td>
<td>Public Skating and Ice Hockey Hall is opened</td>
</tr>
<tr>
<td>2004</td>
<td>Culture Foundation with social archives and library is initiated by former Mayor Urs Widmer and Peter Hauser</td>
</tr>
<tr>
<td>2005</td>
<td>Winterthurer Diesel Pensioners meet at their first yearly gathering</td>
</tr>
<tr>
<td>2008</td>
<td>Winterthur with over 100'900 inhabitants becomes lastingly the 6th largest town of Switzerland</td>
</tr>
<tr>
<td>2011</td>
<td>Verein Diesel Motoren Winterthur is founded</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>New Sulzer Diesel Ltd is renamed to Wärtsilä NSD Switzerland Ltd.</td>
</tr>
<tr>
<td>1997</td>
<td>Total 192 engines of type 16ZA40S ordered for power stations in China PRC (first:1986)</td>
</tr>
<tr>
<td>1997</td>
<td>Wärtsilä NSD Corporation Helsinki stops offering the for years successful four stroke, long stroke engines of Sulzer types S20, ZA40S and ZA50S, despite the intervention of several Shipping Companies at Helsinki. An unbelievable and tragic decision for the employees concerned and also for the loyal clients, considering the world market shares of the ZA40S type alone of up to 20% and in the cruise sector of up to 70%.</td>
</tr>
<tr>
<td>1998</td>
<td>Most powerful Sulzer RTA68T and later RT-flex68T with bore 68cm, stroke 272cm, (D)3130kW/cyl at 95rpm (Jan 2009: at 52 RTA68T, RT-flex68T, RTA68-B, RT-flex68-B, RTA68-D, RTflex68-D with total 1'472'440PSe)</td>
</tr>
<tr>
<td>1998</td>
<td>Test stand for common rail injection and exhaust valve control, both electronically controlled, installed in DTC Oberwinterthur</td>
</tr>
<tr>
<td>1999</td>
<td>Most powerful Sulzer RT-flex60C with bore 60cm, stroke 225cm, (B)2420kW/cyl at 114rpm (Jan 2009: at 35 RT-flex60C, RT-flex60C-B with total 769'000BHP)</td>
</tr>
<tr>
<td>2001</td>
<td>Most powerful Sulzer RT-flex58T-B, world's first low speed engine with common rail injection and electronically-hydraulically controlled injection, exhaust valves and cylinder lubrication on MS Gypsum Centennial in service with 17'340BHP at 105rpm</td>
</tr>
<tr>
<td>2003</td>
<td>Most powerful Sulzer RT-flex50 with bore 50cm, stroke 208cm, (B)1500kW/cyl at 160rpm (Jan 2009: at 25 RT-flex50, RT-flex50 with total 402'000BHP)</td>
</tr>
</tbody>
</table>

Prov 0.E e Sulzer Diesel Engines, Sulzer Diesel Division, Successor Companies, Winterthur Aug 2015-Copyright Bruno Otto Eckert-8472 Seuzach-Switzerland-Ohne Gewähr-©18.07.2015
2012: Winterthurer Diesel Pensioners start to promote „Stories around the Diesel Engines“ and publish them under www.vdmw.ch>Dieselgeschichten

2012: Viesmann Heating Systems Ltd becomes 50 % partner of Hexis Ltd, Winterthur, the latter a Start Up firm for Development, Production and Marketing of Fuelcell Heating and Electricity Modules and part of the Bruno Stefanini Foundation.

End 2012: Winterthur counts 106'542 inhabitants and 65'499 working places.

2013: Provita Health Insurance Ltd, the former Sulzer Health Insurance Organisation is in financial difficulties and is sold to SWICA Ltd, Winterthur

End 2013: Winterthur population: increased to 108'000 inhabitants

2014: 750 Year Celebration of the town rights of Winterthur with events throughout the year under the theme Yesterday-Today-Tomorrow, including the open air exhibition: Historical Industry-, Rail- and Vehicle Technology Experience Days, a unique and remarkable assembly of industrial

2003: 50 Year Jubilee of Sulzer Band

2005: Sulzer Ltd decides to close their Hexis Division, but the Bruno Stefanini Foundation Winterthur steps in and buys the Division in 2006 and forms the Hexis Ltd, such saving the development project of fuel cells heating electricity modules.

2007: Contract of Sulzer Ltd with Wärtsilä Switzerland Ltd expires to use the Sulzer Brand name for the Sulzer type diesel engines

April 2007: Viktor Vekselberg, Russian oligarch buys quietly helds at the end, together with the Austrian Victory Group, 32% of the shares of Sulzer Ltd. The Zürcher Kantonalbank has quietly assisted him in this deal.

Before, Oerlikon Ltd and Saurer Ltd were already taken over.

ZA40S type engined power plant in Europe. Vitoria in Madeira, Portugal with nine 16ZA40S CCM with total 99'300kW-136'000BHP (first engine: 1989), totalling with earlier six 16ZV40 CCM with total 49'700kW-71'200BHP: 15 engines with total 149'000kW-207'200PSe. In 2010, three Wärtsilä W18DF50 engines for gas operation are added.

22nd Sept 2000: Wärtsilä NSD Switzerland Ltd is renamed to Wärtsilä Switzerland Ltd (WCH) Following the merger of Metra Corporation with Wärtsilä NSD Corporation to form Wärtsilä Corporation.

2000: MS Tor Selandia, Tor Suecia and Tor Britannia of Tor Line AB remain the only vessels equipped with ZA50S type engines (each two 9ZA50S GMT with total 21'700kW/29'340PSe), this as a consequence of the Wärtsilä stop of offering the ZA50S engines to owners of older ships.

2002: „Indicator“ Nr 44, the last edition of the employee journal with its name from the NSD time is published. The next edition will be called „IITaktNews“

2006: Most powerful container vessel MS „Emma Maersk“ with ZA40S type engined power plant in Europe. Vitoria in Madeira, Portugal with nine 16ZA40S CCM with total 99'300kW-136'000BHP (first engine: 1989), totalling with earlier six 16ZV40 CCM with total 49'700kW-71'200BHP: 15 engines with total 149'000kW-207'200PSe. In 2010, three Wärtsilä W18DF50 engines for gas operation are added.

2005: RTA82T and later RTA-flex82T with bore 82cm, stroke 337.5cm, 6-9 cyl, 4520kW/cyl at 76-80rpm and RTA-flex82C and RTA-flex82C with bore 82cm, stroke 264.6cm, 6-12 cyl, 4520kW/cyl at 97-102rpm (Jan 2009: at 120 RT-flex82T, RTA82T, RTflex82C, RTA82C with total 5'593'955BHP)

2005: Grandtotal for all A engine types: 6'481 engines with total 7'289'102BHP

2007: Grandtotal of all Z40 types four stroke engines: 1'823 engines with total 17'802'950 BHP

2008: 4RTX-4 „Fourth Technology Demonstrator“, new engine with common rail injection installed in Diesel Technology Center in Oberwinterthur (4RT-flex60)

2009: Test stand for injection for W-X35 with L’Orange injectors installed in DTC Oberwinterthur

2010: 4RTX-5 „Fifth Technology Demonstrator“, for emission- and gas research in Trieste, Italy (4RT-flex50 operating on one cylinder as dual fuel prototype engine)
products of Winterthur

End 2014: Proportional development of confessions in Winterthur from 1850 to 2014 (acc. „Landbote“):
Protestants: 97.7% to 32.7%
Catholics: 2.2% to 24.3%
Other religions or without confession: 0.1% to 42.8%

End 2014: Ten largest employers in Winterthur (acc. „Landbote“):
Town of Winterthur
AXA-Winterthur Insurance
State Hospital
Zurich University of Applied Science ZHaW
Zimmer
Fenaco Groupe
Rieter
Burckhard Compression
Sulzer
Swica Health Insurance

2015: Association responsible for the Sulzer Patient Support Organisation for the past 169 years is dissolved following the sale of Provita Health Insurance Ltd. Their assets are gifted to the cancer organisation Zürich and to the State Hospital Zürich in Winterthur.

2015: Bruno Stefanini Foundation sells their remaining part of 50%

Aug 2007: Vekselberg with his Renova-Holding increase their shares holding of Sulzer Ltd to 31.4% by buying the Sulzer shares held by Victory Group

2009: 175 Year Jubilee of Sulzer Ltd, consisting of the division of Pumps, Metco, Chemtech and Turbo Services with worldwide 12'500 employees

April 2009: At the Sulzer General Assembly, there are 62.5% share votes represented. Vekselberg holds with 31.4% half and replaces the president of the board by his own man.

2011: Metco Division is sold to Oerlikon Ltd.

2012: Sulzer-Innotec is divided as follows:
- Material- and surface coating development to Metco Ltd
- Analytical fluid dynamics and measurements in vibrations and industrial acoustics to Sulzer-Pumps
- Precision Machine Workshop to Sulzer Turbo
- Materials testing destructive and non-destructive, failure and materials analysis, calibration laboratory and welding

one Sulzer 14RT-flex96C of 108’920 BHP (80.1 MW) enters service

2007: Last vessel with ZA40S type engines, the Cruise Liner „Queen Victoria“-90'000GRT of Cunard Steamship Co is delivered (six 16ZA40S WIT with total 89’760BHP)

The modern four stroke, long stroke engines of Sulzer types S20, ZA40S and ZA50S will such become a legend.

2011: Central Spares Distribution Centre of Wärtsilä in Kampen, Netherlands inaugurated

Dec 2013: First order for the dual fuel RT-flex50DF engine announced by Wärtsilä

July 2014: Possible participation of CSSC at Wärtsilä Switzerland Ldt is announced

Jan 2015: Winterthur Gas & Diesel AG is formed for the Engineering out of Wärtsilä Switzerland Ldt with a participation of Chinese State Shipbuilding Corporation (CSSC) of 70% and Wärtsilä Finland of 30%.

7. Wärtsilä Two Stroke Engines

2010: First Wärtsilä Brand two-stroke engines of W-X35 and W-X40 series are announced (5-8 cyl, bores 35 and 40cm, strokes 155 and 177cm, 870kW/cyl at 167rpm and 1135kW/cyl at 146rpm)

2012: W-X92 series as successor of RT-flex96C is announced (6-12 cyl, bore 92cm, stroke 346.8cm, 6130kW/cyl at 76-88rpm)

2012: W-X62 and W-X72 series based on RT-flex82 are announced (4-8cyl, bores 62 and 72cm, strokes 265.8 and 308.6cm, 2660BHP/cyl at 97-103rpm and 3610kW/cyl at 84-89rpm)

2012: RT-flex50 (RTX-5) operating on one cylinder as dual fuel prototype engine is presented in Trieste, Italy to the industry

2013: W-X82 series is announced (6-8 cyl, bore 82cm, stroke 337.5cm, 6130kW/cyl at 76-88rpm)

2014: 4RTX-6 „Sixth Technology Demonstrator“, with common rail in DTC Oberwinterthur (4RT-flex60, modified to bore 60cm)
of Hexis Ltd, Winterthur to Viesmann Heating System Ltd too. They are now the sole owner of this firm for development, production and marketing of fuelcell heating electricity modules and plan to expand the production in Winterthur.

2015: Winterthur, Town with over 17 Museums and Art Galleries: (www.kultur.winterthur.ch and tourismus@win.ch)

Of technology are sold in Oct 2013 to Qualitech Ltd, Mägenwil, Switzerland, facilities with the 60 employees remain in Oberwinterthur.

Such a long tradition of technical and personal relationship between the „Diesel“ and Innotec is ended.

June 2015: Precision Machine Workshop is closed, as Sulzer Ltd will focus more on the core business of their divisions.

Wärtsilä remains as Brand Name.

Both new firms have their headquarter in Winterthur and remain in the same building, carrying the nicknames „Dam“ and „Chinese Wall“ already for decades….

8. Number of Sulzer Type Engines build or ordered until Jan 2009

<table>
<thead>
<tr>
<th>Sulzer Engine Type</th>
<th>Number build or ordered</th>
<th>Total Output BHP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two-stroke low-speed</td>
<td>11’459</td>
<td>178’888’745</td>
</tr>
<tr>
<td>Two-stroke medium-speed</td>
<td>7’422</td>
<td>6’790’054</td>
</tr>
<tr>
<td>Four-stroke medium-speed</td>
<td>25’829</td>
<td>43’448’150</td>
</tr>
<tr>
<td>SLM engines, 1962 onwards</td>
<td>743</td>
<td>218’016</td>
</tr>
<tr>
<td>Total of all engines by end Jan 2009</td>
<td>45’453</td>
<td>229’344’965</td>
</tr>
</tbody>
</table>

All datas taken from „Summary Statistic at End Jan 2009 of Sulzer Diesel Engines 1903-2009“, incl Wärtsilä low-speed engines from 2006, by D T Brown, Febr 2009

His additional comment of 01.03.2015: Regarding the statistic on the numbers of Sulzer engines built, of any type. there was never any definitive record and there were inconsistancies. There are probably still some more Sulzer engines out there of which we have no record.
9. Some Running Hours of Engines

23.04.201 (LS): MV Manoa (ex President Lincoln APL1)-12RND90M build by Allis Chalmers (Milwaukee): 200'000 running Hours since 1981


12.01.2015 (KA): 2 x 8 RLBF90 MHI in Diesel Power Station Rockfort US: 209’000 running hrs

10. Licensing

10.1 Licensing by Sulzer 1909-2009

Since 1909, more than 100 companies in 30 countries have been licensed at various times to build Sulzer diesel engines, or Wärtsilä low-speed engines.

In 2009, agreements exist with totally 17 licencees in eight countries.

Key features of licence and co-operation agreements: True long-term partnership, normally 15 years and Split of functions, central R&D and local manufacture

10.2 Early Sulzer Diesel Licensees

It is believed that Sulzer Brothers’ first licence agreement was granted to the Schweizerische Automobil-Fabrik in Rheineck (SAFIR) which was founded in November 1906 to develop and manufacture automotive diesel engines. It would have needed a sub-licence from Sulzer Brothers who then held the Swiss patent rights for the diesel engine. However, no record can be found of such an agreement.

1909: SLM, Winterthur, Switzerland
1909: Lang, Budapest, Hungary
1910: Soc. des Forges & Chantiers de la Méditerranée, France
1911: Busch-Sulzer Brothers-Diesel Engine Co, USA
1911: Erste Brünner Maschinenfabrikges., Brno, Czech Republic
1913: William Denny & Brothers, Great Britain
1915: Howaldtswerke, Kiel, Germany

Prov 0.E e Sulzer Diesel Engines, Sulzer Diesel Division, Successor Companies, Winterthur Aug 2015-Copyright Bruno Otto Eckert-8472 Seuzach-Switzerland-Ohne Gewähr-©18.07.2015
1915: Soc. Italiano Gio. Ansaldo & Co, Genoa, Italy
1915: SA des Ateliers & Chantiers de la Loire, France
1916: A/S Thunes Mek. Verksted, Oslo, Norway
1916: Ateliers de Kolomna & Sormova, St Petersburg, Russia
1916: Royal Norwegian Navy, Oslo
1917: Soc. Española de Construcciones Metalicas, Bilbao, Spain
1917: Imperial Japanese Navy, Tokyo
1918: Compagnie de Construction Mécanique Procédés, Paris, Works in St Denis (CCM)
1918: Kobe Steel Works, Kobe, Japan

10.3 Licencees of New Sulzer Diesel Ltd in 1996

In 1996, prior to the sale of New Sulzer Diesel Ltd, exist licence agreements with totally 22 licencees in 13 countries:

Cockerill Mechanical Industries, Seraing, Belgium
Industrias Verolme Ishibras SA, Rio de Janeiro, Brazil
China State Shipbuilding Corporation, Beijing, China PRC
3. Maj Engines & Cranes, Rijeka, Croatia
Adriadiel DD, Karlovac, Croatia
Wärtsilä Diesel International SARL, Strasbourg, France
New Sulzer Diesel France SA, Mantes-la-Ville, France (NSD-CCM)
Dieselmotorenwerke Vulkan GmbH, Bremen, Germany
Fincantieri Cantieri Navali Italiani SpA, Divisione Motori Diesel, Trieste, Italy
Diesel United Ltd, Tokyo, Japan
Hitachi Zosen Corporatio, Osaka, Japan
Mitsubishi Heavy Industries Ltd, Tokyo, Japan
NKK Corporation, Tokyo, Japan
Hyundai Heavy Industries Co Ltd, Changwon, Korea ROK
Korea Heavy Industries & Constructions Co Ltd, Changwon, Korea ROK
Samsung Heavy Industries Co Ltd, Changwon, Korea ROK
Ssangyong Heavy Industries Co Ltd, Seoul, Korea ROK
Zaklady Przemyslu Metalowega H Cegielski, Poznan, Polen
Zaklady Urzadzen Technicznych Zgoda SA, Swietochlowice, Polen
Manises Diesel Engine Company SA, Valencia, Spain
Türkiye Gemi Sanayil SA, Istanbul, Turkey
Waukesha Engine Division, Dresser Industries, Inc, Waukesha, USA

Prov 0.E e Sulzer Diesel Engines, Sulzer Diesel Division, Successor Companies, Winterthur Aug 2015-Copyright Bruno Otto Eckert-8472 Seuzach-Switzerland-Ohne Gewähr-©18.07.2015
10.4 Diesel Licensing of Wärtsilä Corp, Finland from 2000 - 2009

2000: HSD Engine Co Ltd with two factories at Changwon, formed by merger of diesel engine building activities of Samsung and Hanjung (KHIC) with Daewoo as a shareholder. Later company name changed to Doosan Engine Co Ltd.
2002: China Steel Machinery Corporation, Kaohsiung, Taiwan, Republic of China. This company was formerly TMMC whose licence signed in 1974 had previously lapsed.
2005: Nuclebrás Equipamentos Pesados SA (NUCLEP), Itaguai, Rio de Janeiro, Brazil
2007: Vietnam Shipbuilding Industry Corporation (Vinashin), Hanoi, Vietnam
2007: Bryansk Engineering Works, JSC of closed type (BMZ), Bryansk, Russia. Subsidiary of Transmashholding JSC of closed type, Moscow, Russia.
2007: Jiangsu Rongsheng Heavy Industries Group Co Ltd (RSHI), China, for the works of Hefei RongAn Power Machinery Co Ltd (RPM), Hefei, Anhui Province, China.
2008: Zhenjiang CME Co Ltd (CME), China PRC, or the works in Zhenjiang, Jiangsu Province, China PRC. CME is a subsidiary of China State Shipbuilding Corp, Beijing, China PRC (see above).
2008: CSSC-MES Diesel Co Ltd (CMD), China PRC, for the works in Shanghai, China PRC. CMD is a joint venture of China State Shipbuilding Corp, China CSSC Holdings Ltd and Mitsui Engineering & Shipbuilding Co Ltd.
2009: Zhuhai Yuchai Marine Power Co Ltd (YMP), China PRC, for the works in Zhuhai, Guangdong Province, China PRC. YMP is a subsidiary of Guangxi Yuchai Machinery Group Co Ltd, China PRC.

10.5 Diesel Joint Venture of Wärtsilä Corp, Finland in 2006

Qingdao Qiyao Wärtsilä MHI Linshan Marine Diesel Co Ltd, China PRC, announced Sept 2006:
A joint venture between China Shipbuilding Industry Corporation (CSIC), Wärtsilä Corporation, Finland and Mitsubishi Heavy Industries Ltd (MHI), Japan for the manufacture of large low-speed marine diesel engines. The joint-venture agreement was signed by Qingdao Qiyao Linshan Power Development Co Ltd (QQLPDC) and Panda Shinco Holding BV (PSH).
QQLPDC is jointly owned by Yichang Marine Diesel Plant (YMD) and Shanghai Marine Diesel Engine Research Institute (SMDERI), both being underlying units of CSIC.

PSH is jointly owned by Wärtsilä and MHI.

11. Editorial

11.1 Publications and further Contributions

Publications: For any publication of this Essay, also partly, please quote the source and provide the author with a respective copy.

Translations: For any publication of this Essay, also partly, in a translated version other than German, please quote the source and provide the author with a respective copy.

Thank you for your cooperation, the author eckertbruno@bluewin.ch

11.2 The Author

Bruno Otto Eckert-Martin, dipl Maschineningenieur FH, born 1937, grown up, educated and living mainly in Winterthur, Switzerland until 1980. Then he moves with his family to the nearby village Seuzach. He joined Sulzer Bros Ltd, Winterthur in 1961 as a development designer in the Prototype Diesel Engine Dept and changed in 1962 to Sulzer (UK) Ltd in London into the Spares and Service Dept. On his return in 1964 he started as Commissioning and Service Engineer in the Technical Diesel Service, worldwide known as famous „0736“. From 1968-1969, parallel to his work, he takes a Diploma Course for a Teacher for Apprentices. From 1969-1973 he lived in Mumbay as Technical Delegate for the Diesel Engine Division of Sulzer Ltd responsible for India and Pakistan, married but not yet with the later son and daughter. On his return in 1973, he was appointed as Head of the Technical Service for Four Stroke Engines and later as Manager of the Customer Assistance for Sulzer Type Engines, the Diesel Training Center and the Technical Information to Customers. His considerable and interesting business travelling brings him to most countries in the world. Concluding he worked until his retirement in 2000 from Wärtsilä Switzerland Ltd, the successor of New Sulzer Diesel Ltd and Diesel Engine Division of Sulzer Ltd. Almost unnecessary to add, he is also a member of the Sulzerband as Clarinetist and acted as its Secretary for many years.
12. Sources chronological and Acknowledgments

- Alt-Winterthur von Dr K Hauser, Ausgabe 1921, Historisch-Antiquarischen Verein Winterthur

- Festbuch zum Jubiläum 100 Jahre Gebrüder Sulzer 1834-1934, Ausgabe 1934 durch Gebrüder Sulzer AG mit Vorwort von Hans Sulzer und Beiträgen ohne Autoren-Angaben


- Technische Rundschau Sulzer Nr.2/1947, gewidmet den 50 Jahren Sulzer-Dieselmotoren 1897-1947 mit Beiträgen von H S Kilchenmann, W Bangerter und O Schlaepfer

- Winterthur Stadtbilder von Paul von Moos, Ausgabe 1953, Verlag W. Vogel, Winterthur


- Sulzer Mini Motorenprogramms, single ones between 1972 and 1986

- Siedlungs- und Baudenkmäler im Kanton Zürich, Ausgabe 1976, Direktion der öffentlicher Bauten des Kt Zürichs, Verlag Th Gut, Stäfa


- The Rotating Piston, 50 Years On, by David T Brown and Bruno O Eckert, June 1988, Sulzer Brothers Ltd, Winterthur

- Sulzer Mini Motorenprogramms, single between 1988-2002

- 1310 Grad Celsius, Grossgiesserei Sulzer von Andreas Wolfensberger und Alois Bischof, AS Buchkonzept, Zürich, 1993

- From th Mountains to the Sea, The Sulzer Diesel Engine, Wärtsilä NSD Switzerland Ltd, 1998

- Festschrift 175years Experience Sulzer, Ausgabe 2008 durch Sulzer AG, Corporate Communications

- Brief overview with some highlights from 115 years of research, development, design and manufacture, 1893–2008 by David Brown, Jan 2009

- Ingenieure bauen die Schweiz, Technikgeschichte aus erster Hand, Schweizer Maschinen vom 2012, Herausgeber Franz Betschon, Stefan Betschon, Jürg Lindecker und Willy Schlachter, NZZ Verlag, Abschnitt 2.1 Schweizer Maschinen auf grosser Fahrt, Pionierleistungen bei der Entwicklung von Dieselmotoren von Herbert Zehnder und George Lustgarten

- Sulzer Diesel Engines 1903-2009, incl Wärtsilä low-speed engines from 2006, Summary Statistic at End Jan 2009 by D T Brown, Febr 2009. His additional comment on 01.03.2015: Regarding the statistic on the numbers of Sulzer engines built, of any type. there was never any definitive record and there were inconsistancies. There are probably still some more Sulzer engines out there of which we have no record.


- Wärtsilä Services Product Catalogue 2013

- 750 Jahre Winterthur, Stadtrecht seit 1264, Jahresprogramm 2014, Dez 2013

- Sulzer diesel engine licensees past and present up to 2009, by DTB, Dec 2014


- Stadtarchiv Winterthur www.stadtarchiv.winterthur.ch und Studienbibliothek Winterthur www.winbib.ch

- Brochure Winterthur Museen (www.kultur.winterthur.ch)

- Winterthur Tourismus (www.winterthur-tourismus.ch)

- Winterthur Glossar (www.winterthur glossar.ch)

- School of Engineering of Zurich University of Applied Sciences ZHaW (www.zhaw.ch)
- Daily papers: Der Landbote, Tagblatt von Winterthur und Umgebung, Neue Zürcher Zeitung, Basler Zeitung

- Diesel Stories of the Dieselpensionierten Winterthur (www.vdmw.ch > Dieselgeschichten)

- Colleges from the author's Dieseltme: AD, KA, CB, DB, HB, PB, EJ, GL, RM, LS, AR, AS, BS, CS, PGS, PS, StS, AW, HZ and individual support from persons of other companies or institutions: AB, JB, MB, EG, RG, AI, EK, RK, BM, NR

- Many thanks indeed for the assistance and support received