13. Site, Building and Infrastructure

13.1 Introduction

The layout of the building is determined by the circumference of the storage ring, the length of the beam lines, the space for the offices, laboratories, workshops and the housing of the infrastructure. The first draft design for the SESAME building has been made in 1998 and is presented in the "Green Book". It is a round building similar to BESSY I. According to the circumference of the machine (~100 m) and the length of the beam lines (~30 meters) the building had a diameter of 80 meters. In order to save space, some parts of the experimental hall should be used for the installation of the infrastructure.

The building can be erected with concrete and bricks or steel structure. A problem for the construction is the long span if a crane should cover the whole experimental hall. The crane is more or less a necessary "must" for the erection of the storage ring as well as the beam lines and the solution could only be the steel structure. With the building of ANKA there exist one example. The experimental hall of ANKA has a free area of 60m* 60m and this free area is covered with a crane. The storage ring of ANKA has, with a circumference of 110.4 meters, roughly the same size as SESAME. In order to save money the decision was made to use in general the ANKA experimental hall. To get the required space for offices, workshops etc., the two-storey annex, which exist at ANKA at one side, should go around the whole building.

5 member states proposed sites for the synchrotron light source SESAME. An international selection committee selected as the residence of SESAME the site at Allan in Jordan (see the yellow arrow in the Figure (13.1)). The estate in Allan belongs to the Al-Balqa-Applied-University, which runs here a college. The estate is hilly and covers an area of 1km*1.5km. The "Allan-site" is roughly 30km north of Amman, the Capital of Jordan. From Amman a main street is passing Allan. The site will be reached from this main street by a small road. The length of this road is only 300 to 400 meters. There don't exist any problems to reach the site with heavy tracks. Furthermore it is easy to reach the Allan site from the airport.

13.2 The SESAME Building

The layout of the ground floor is presented in Figure (13.2). The main part of the ground floor is the experimental hall with an overall space of 4500 m^2. At each side of the experimental hall there is a cut-out of annex with a space of 225 m^2 each, which belongs to the experimental hall. The reason for the cut-outs is to increase the length of the beam lines. At the side with the main entrance this cut out will be used as a reception area. Around the experimental hall there is a corridor or pathway with a width of 2 m.

If it is assumed that the circumference of the machine is 120 m, the lengths of the beam lines varies (from the source point to the walls) between 27m and 32 m. Most of the beam lines have a length of 29m. According to the existing beam lines at ANKA this length should be sufficient. All the beam lines at SPEAR and NSLS in Brookhaven have also lengths in this range.

In each corner of the building there are workshops and laboratories. Overall there are 12 large and 1 small laboratories, with an overall space of 688 m^2. The mechanical workshop has a space of 82 m^2 and the electrical one of 55 m^2 (see Figure (13.2)). From one side there is an entrance for trucks to unload heavy things. From the truck it is possible to perform the unloading and the placing with the crane. At two sides there is a social area with a small kitchen (buffet) and the toilets. At each side there is a staircase to reach the first floor and vice versa.

Figure 13.1: The map of the "Middle East Region" and an extract of the map of Jordan. The yellow arrow in this map indicates the location of SESAME.

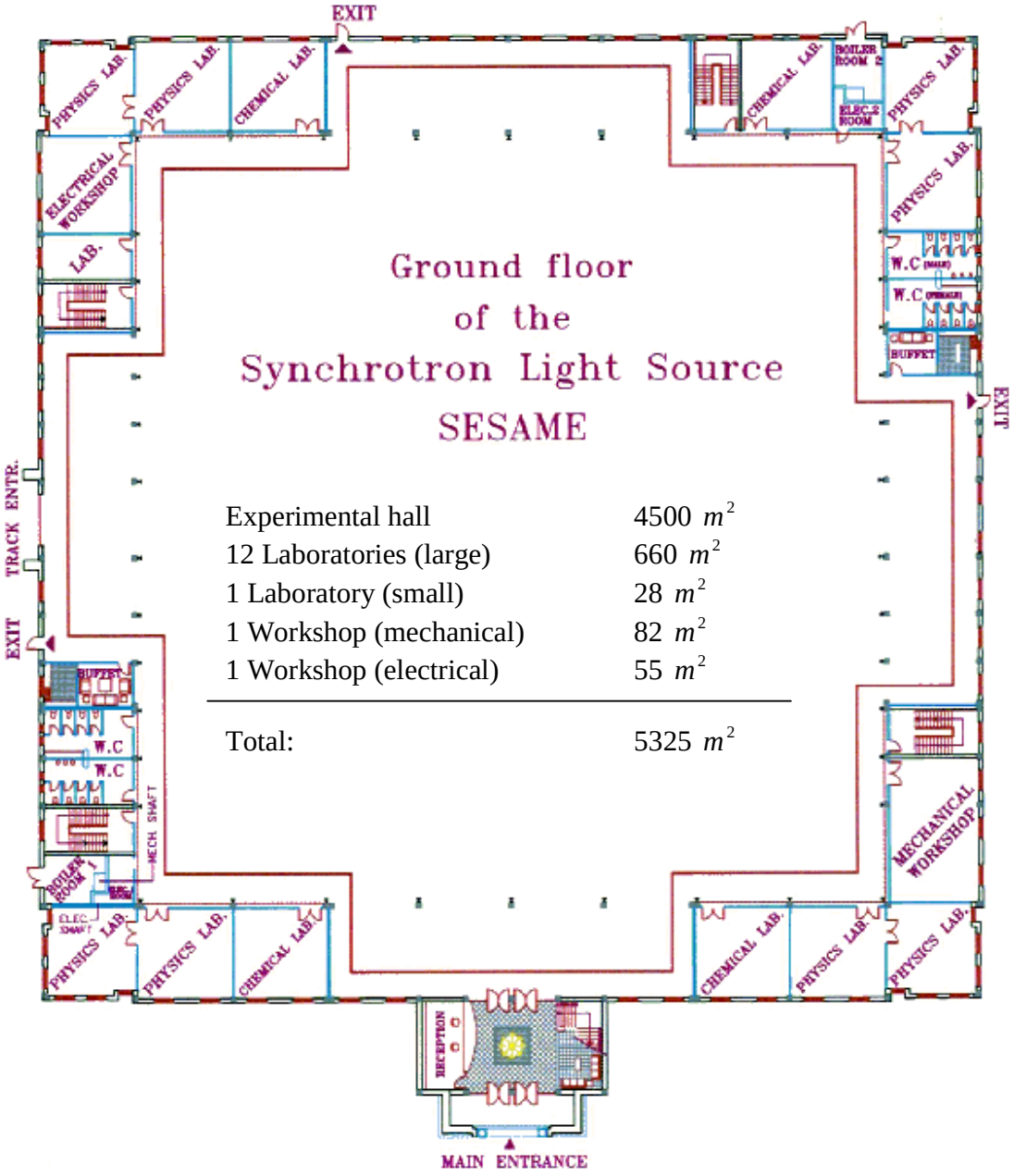


Figure 13.2: Ground floor of the synchrotron light source SESAME

The layout of the first floor is presented in Figure (13.3) with the administration area (including 3 director offices, 1 meeting room), 3 secretary offices, 20 staff offices, 3 buffets, 3 service rooms, 1 store -, 1 maintenance -, control -, 1 seminar -, 2 meetings – and 1 library. The space for these rooms is given in Figure (13.3). Not shown in Figure (13.3) is the gangway with the access to the inner side of the storage ring (see Figure (13.7)). This gangway will also be used for the supply of the needed infrastructure (electricity, cooling, etc.) to the inner side of the storage ring.

Table 13.1: Rooms, workshops and laboratories on the ground floor

Description	Number	Area [m^2]	Total Area [m^2]
Experimental hall	1		4500
Rectangular area	1	3600	
Cut outs	4	225	
Physical laboratories	8	55	440
Chemical laboratories	4	55	220
Laboratory	1	28	27
Mechanical workshop	1	82	82
Electrical workshop	1	55	55
Boiler rooms	2	28	56
Kitchens / buffets	2	20	40
Female / male toilets	2	55	110
Staircase	3	28	84
Total			5614

With the 4500 m^2 of the experimental area, the ground space of the building is 5614 m^2. Converting this area to a circle, it means a radius of 42.30 m. In the “Green Book” a radius of 40 m was foreseen

Table 13.2: Available rooms in the administration area of the first floor

Description	Number	Area [m^2]	Total Area [m^2]
Reception area	1	188	188
Director	1	50	50
Director	2	37	74
Secretary	3	18	54
Office	3	18	54
Meeting	1	37	37
Storage	1	18	18
File storage	1	18	18
Kitchen	1	18	18
Toilet (female/male)	1	37	37
Toilet (female/male)	1	18	18
Total			566

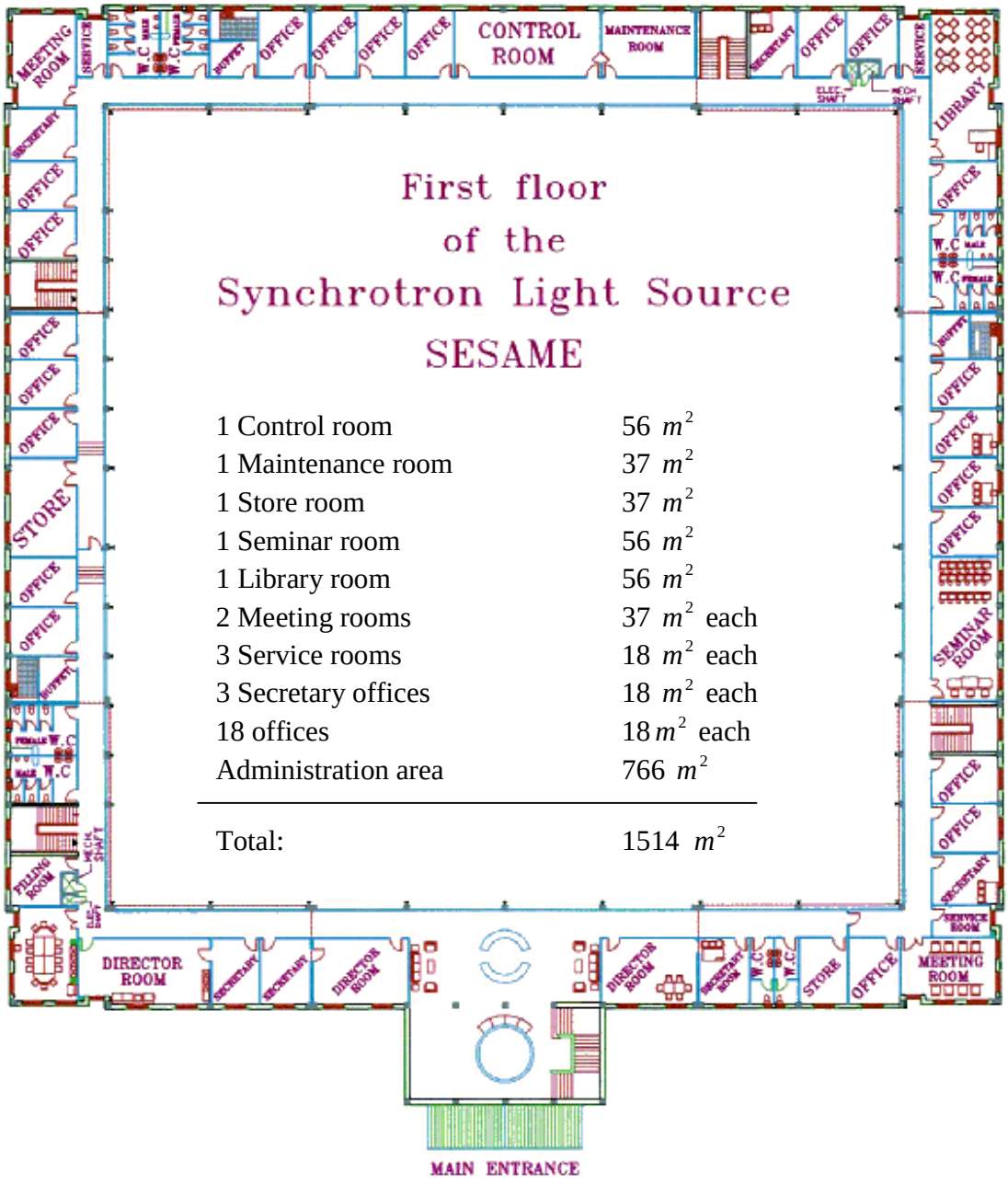


Figure 13.3: First floor of the synchrotron light source SESAME

The elevation of the building from the different sides is presented in the Figures (13.4) to (13.6). Indicated in these figures is also the existing level of the soil to show the hilly structure of the site. Figure (13.4) shows the side with the main entrance and in Figure (13.5) the technical building is indicated.

Table 13.3: Available rooms in the "control area" of the first floor

Description	Number	Area [m^2]	Total Area [m^2]
Control	1	56	56
Maintenance	1	37	37
Library	1	56	56
Secretary	1	18	18
Office	6	18	108
Service	1	18	18
Kitchen	1	37	37
Toilette	1	18	18
Staircase	1	18	18
Total			366

Table 13.4: Available rooms in the "office right area" of the first floor

Description	Number	Area [m^2]	Total Area [m^2]
Meeting	1	37	37
Seminar	1	56	56
Secretary	1	18	18
Office	7	18	126
Service	1	12	12
Kitchen	1	18	18
Toilette	1	37	37
Staircase	1	18	18
Total			322

Table 13.5: Available rooms in the "office left area" of the first floor

Description	Number	Area [m^2]	Total Area [m^2]
Meeting	1	37	37
Storage	1	37	37
Secretary	1	18	18
Office	5	18	90
Service	1	12	12
Staircase	1	18	18
Total			212

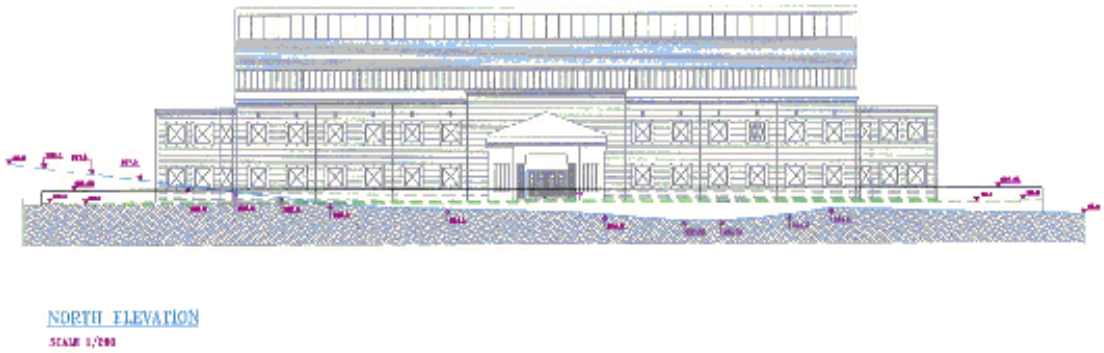


Figure 13.4: North elevation of the SESAME building and the main entrance

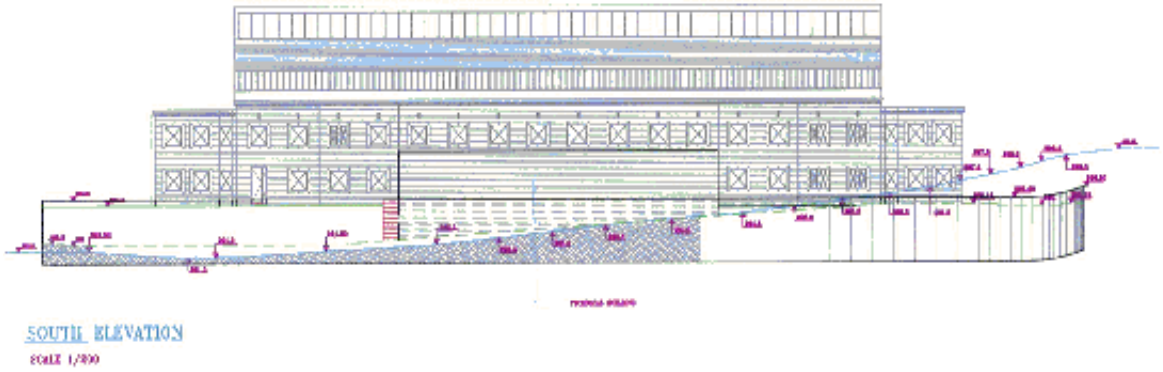


Figure 13.5: South elevation of the building and the back side of the technical building

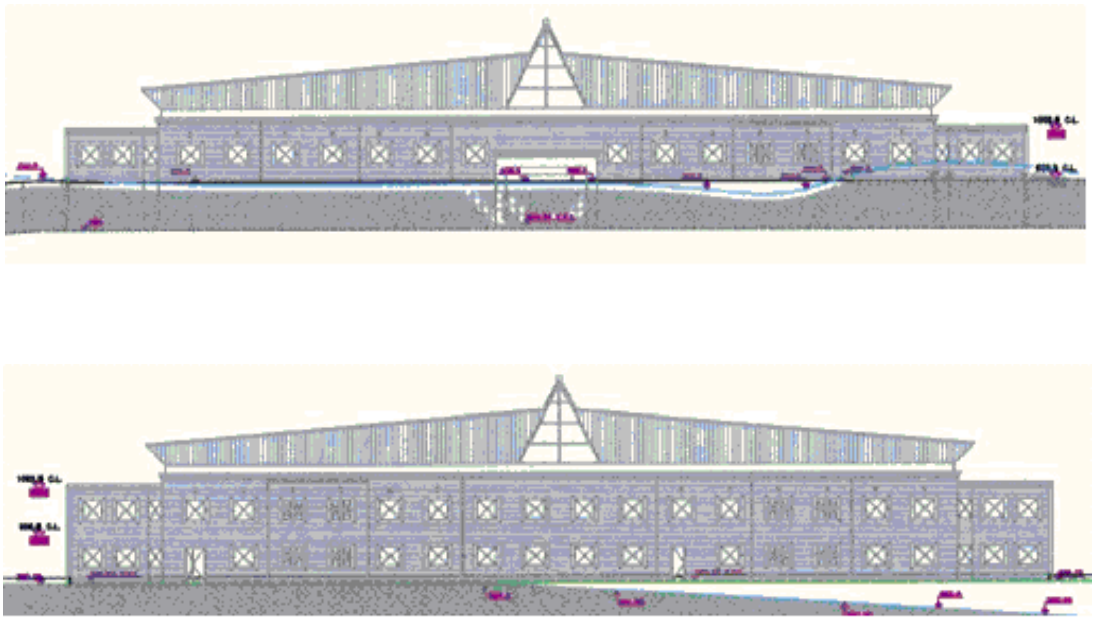


Figure 13.6: East and west elevation of the SESAME building

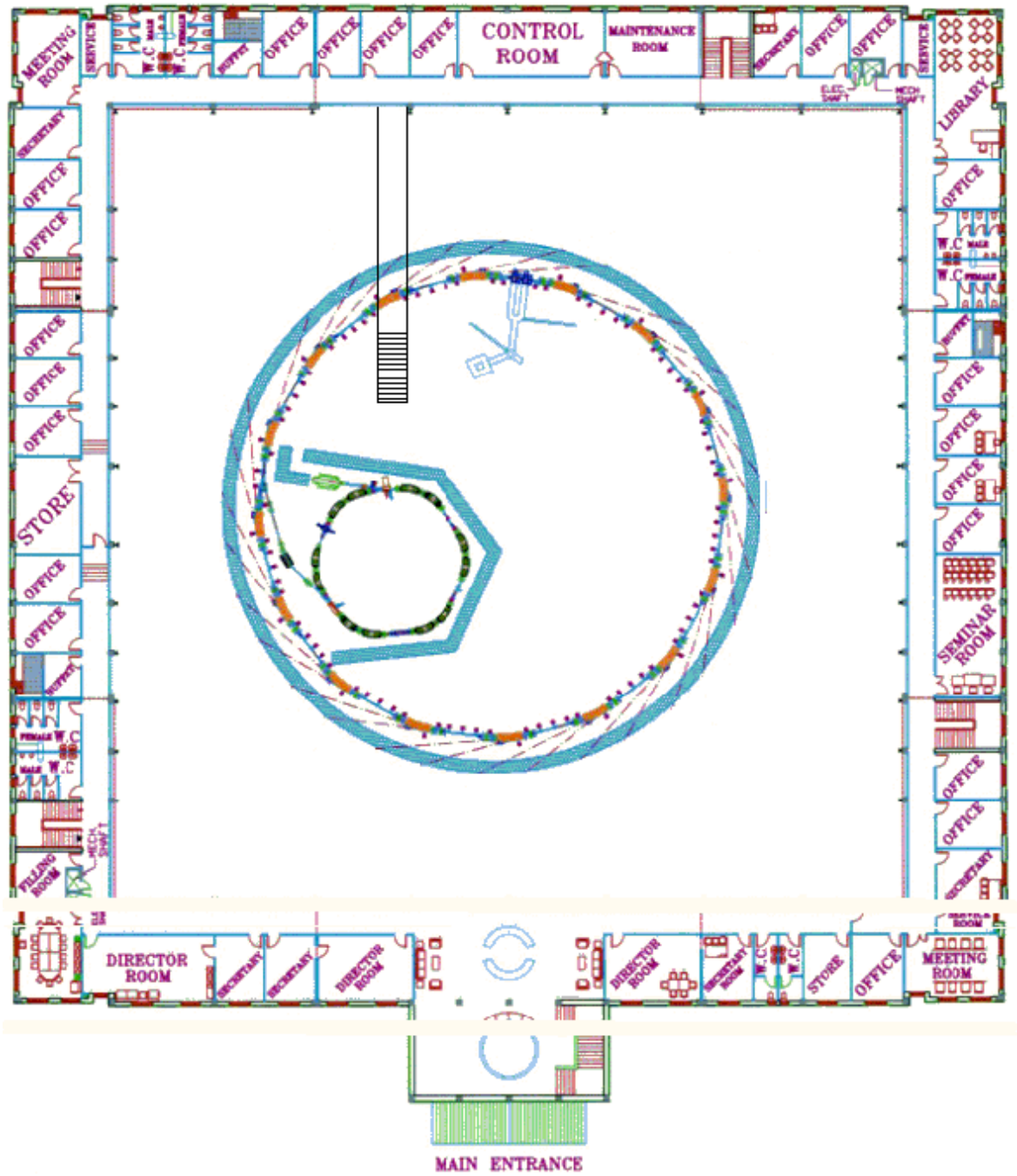


Figure 13.7: The layout of the first floor of the synchrotron light source SESAME with a view of the ground floor. Indicated is the location of the storage ring with the shielding wall around the accelerator and the bridge for having access to the storage ring area. All equipments for running the storage will be placed inside the shielding wall.

Table 13.6: The mechanical infrastructure (water, gas, etc) for the laboratories and workshops of the ground floor

INFRASTRUCTURE FOR THE GROUNDFLOUR

MECHANICS

ROOM	Coordinates	Description	Pr-Air	Wa+Dr	Ch-Ou	Ch-Ex	Da-Sh	Ai_Ex	Dr-Ni	He
Experimental Hall			Yes	Yes				Yes	Yes	Yes
Physics Laboratory	K-J / 11-12	Microscopy	4 times	Yes			Yes			
Physics Laboratory	I-H / 11-12		4 times	Yes				Yes	Yes	
Chemical Laboratory	H-G / 11-12		4 times	Yes	Yes	Yes				
Chemical Laboratory	C-B / 11-12	Clean Room	4 times	Yes	Yes	Yes				
Physics Laboratory	B-A / 11-12	Sample Prepar.	4 times	Yes						
Physics Laboratory	L-M / 11-12	UHV Vac.-Labor.	4 times	Yes				Yes	Yes	
Mechanical Workshop	L-M / 9-10	Machine Shop	4 times	Yes						
Special Laboratory	L-M / 9-8.5		2 times	Yes						
Staircase	L-M / 8.5-8									
Buffet	L-M / 4.5-4									
W.C. (FEMALE)	L-M / 4-3.5									
W.C. (MALE)	L-M / 3.5-3									
Physics Laboratory	L-M / 3-2		4 times	Yes					Yes	
Physics Laboratory	L-M / 1-0	Optical Labor.	4 times	Yes			Yes	Yes	Yes	
Boiler Room	A-A.5 / 1-0									
Chemical Laboratory	A.5-B.5 / 1-0		4 times	Yes	Yes	Yes				
Staircase	B.5-C / 1-0									
Chemical Laboratory	G-H / 1-0	Protein Chemistry	4 times	Yes	Yes	Yes				
Physics Laboratory	H-I / 1-0	Cold Room	4 times	Yes						
Physics Laboratory	J-K / 1-0	Molecular Biology	4 times	Yes						
Electrical Workshop	J-K / 2-3	Electronic Shop	4 times	Yes						
Special Laboratory	J-K / 3-3.5		2 times	Yes						
Staircase	J-K / 3.5-4									
Buffet	J-K / 7.5-8									
W.C. (FEMALE)	J-K / 8-8.5									
W.C. (MALE)	J-K / 8.5-9									
Staircase	J-K / 9-9.5									
Boiler Room	J-K / 9.5-10									

Pr-Air: Pressure Air, Wa+Dr: Water and draining, Ch-Ou: Chemical Outlet, CH-Ex: Chem
Da-Sh: Darkeining Shutters, Ai-Ex: Air Exhaust, Dr-Ni: Dry Nitrogen, He: Helium

For the beamlines we have the following utilities:
Cooling water, cooling water for HVAC, dry nitrogen, pressure air, helium, exhaust systen

Table 13.7: The electrical infrastructure (sockets, LAN, etc) for the laboratories and workshops of the ground floor

INFRASTRUCTURE FOR THE GROUNDFLOUR

ELECTRICITY

ROOM	Coordinates	Description	El-Di	So-Li	So	Lo-Ne	Cl-Ne
Experimental Hall			8 times				
Physics Laboratory	K-J / 11-12	Microscopy	1 times	8 times		Yes	Yes
Physics Laboratory	I-H / 11-12		1 times	8 times		Yes	Yes
Chemical Laboratory	H-G / 11-12		1 times	8 times		Yes	
Chemical Laboratory	C-B / 11-12	Clean Room	1 times	8 times		Yes	
Physics Laboratory	B-A / 11-12	Sample Prepar.	1 times	8 times		Yes	Yes
Physics Laboratory	L-M / 11-12	UHV Vac.- Labor.	2 times	8 times		Yes	Yes
Mechanical Workshop	L-M / 9-10	Machine Shop	4 times	8 times		Yes	
Special Laboratory	L-M / 9-8.5		1 times	4 times		Yes	Yes
Staircase	L-M / 8.5-8				Yes		
Buffet	L-M / 4.5-4				Yes		
W.C. (FEMALE)	L-M / 4-3.5				Yes		
W.C. (MALE)	L-M / 3.5-3				Yes		
Physics Laboratory	L-M / 3-2		1 times	8 times		Yes	Yes
Physics Laboratory	L-M / 1-0	Optical Labor.	1 times	8 times		Yes	Yes
Boiler Room	A-A.5 / 1-0				Yes		
Chemical Laboratory	A.5-B.5 / 1-0		1 times	8 times		Yes	
Staircase	B.5-C / 1-0				Yes		
Chemical Laboratory	G-H / 1-0	Protein Chemistry	1 times	8 times		Yes	
Physics Laboratory	H-I / 1-0	Cold Room	1 times	8 times		Yes	Yes
Physics Laboratory	J-K / 1-0	Molecular Biology	1 times	8 times		Yes	Yes
Electrical Workshop	J-K / 2-3	Electronic Shop	2 times	8 times		Yes	Yes
Special Laboratory	J-K / 3-3.5		1 times	4 times		Yes	Yes
Staircase	J-K / 3.5-4				Yes		
Buffet	J-K / 7.5-8				Yes		
W.C. (FEMALE)	J-K / 8-8.5				Yes		
W.C. (MALE)	J-K / 8.5-9				Yes		
Staircase	J-K / 9-9.5				Yes		
Boiler Room	J-K / 9.5-10				Yes		

El-Di: Electricity Diystributor with 3 times 220V,16A; 1 times 380V,16A; 1 times 380V,32A
So-Li: Socket line.This is a cable channel around the room in a height of 1.4 m with sockets 220V,16A
So: Socket (220 V,16A), Lo-Ne: Local Area Network, Cl-Ne: clean-net sockets

Table 13.8: Mechanical and electrical infrastructure for the rooms and offices of the first floor

INFRASTRUCTOR FIRST FLOOR

Mechanic and Electricity

Coordinates	Description	Water and draining	Local Area Network	Sockets 220 Volt	Sockets "clean net"
K-J / 11-12	Meeting Room		Yes	4 times	
J-H / 11-12	Director Room		Yes	4 times	
H-H.5 / 11-12	Secretary Room	Yes	Yes	2 times	
H.5-G / 11-12	Secretary Room	Yes	Yes	2 times	
G-F / 11-12	Director Room		Yes	4 times	
F-D / 11-12	Entrance			4 times	
D-C / 11-12	Director Room		Yes	4 times	
C-C.5 / 11-12	Secretary Room		Yes	2 times	
C.5-C.75 / 11-12	W.C. (Female)	Yes		1 times	
C.75-B / 11-12	W.C. (Male)	Yes		1 times	
B-B.5 / 11-12	Store Room			2 times	
B.5-A / 11-12	Office		Yes		
L-M / 11-12	Meeting Room		Yes	4 times	
L-M / 12.75-11	Service Room			2 times	
L-M / 10-9.5	Secretary Room	Yes	Yes	2 times	
L-M / 9.5-9	Office		Yes	4 times	
L-M / 9-8.5	Office		Yes	4 times	
L-M / 8.5-8	Staircase			2 times	
L-M / 8-7.5	Office		Yes	4 times	
L-M / 7.5-7	Office		Yes	4 times	
L-M / 7-6´	Office		Yes	4 times	
L-M / 6´-6	Office		Yes	4 times	
L-M / 6-5´	Office		Yes	4 times	
L-M / 5´-5	Office		Yes	4 times	
L-M / 5-4.5	Office		Yes	4 times	
L-M / 4.5-4	Buffet	Yes		2 times	
L-M / 4-3.5	W.C. (Female)	Yes		1 times	
L-M / 3.5-3	W.C. (Male)	Yes		1 times	
L-M / 3-2.5	Office		Yes	4 times	
L-M / 2.5-0	Seminar Room		Yes	8 times	
A-B.5 / 1-0	Library		Yes	8 times	
B.5-C / 1-0	Staircase			2 times	
C-C.5 / 1-0	Secretary		Yes	2 times	
C.5-D / 1-0	Office		Yes	4 times	
D-E.5 / 1-0	Control Room		Yes	12 times	8 times
E.5-F.5 / 1-0	Maintenance		Yes	10 times	6 times
F.5-G / 1-0	Office		Yes	4 times	
G-G.5 / 1-0	Office		Yes	4 times	
G.5-H / 1-0	Buffet			2 times	
H-H.5 / 1-0	W.C. (Male)	Yes		1 times	
H.5-I / 1-0	W.C. (Female)	Yes		1 times	
I-K / 1-0	Meeting Room		Yes	4 times	

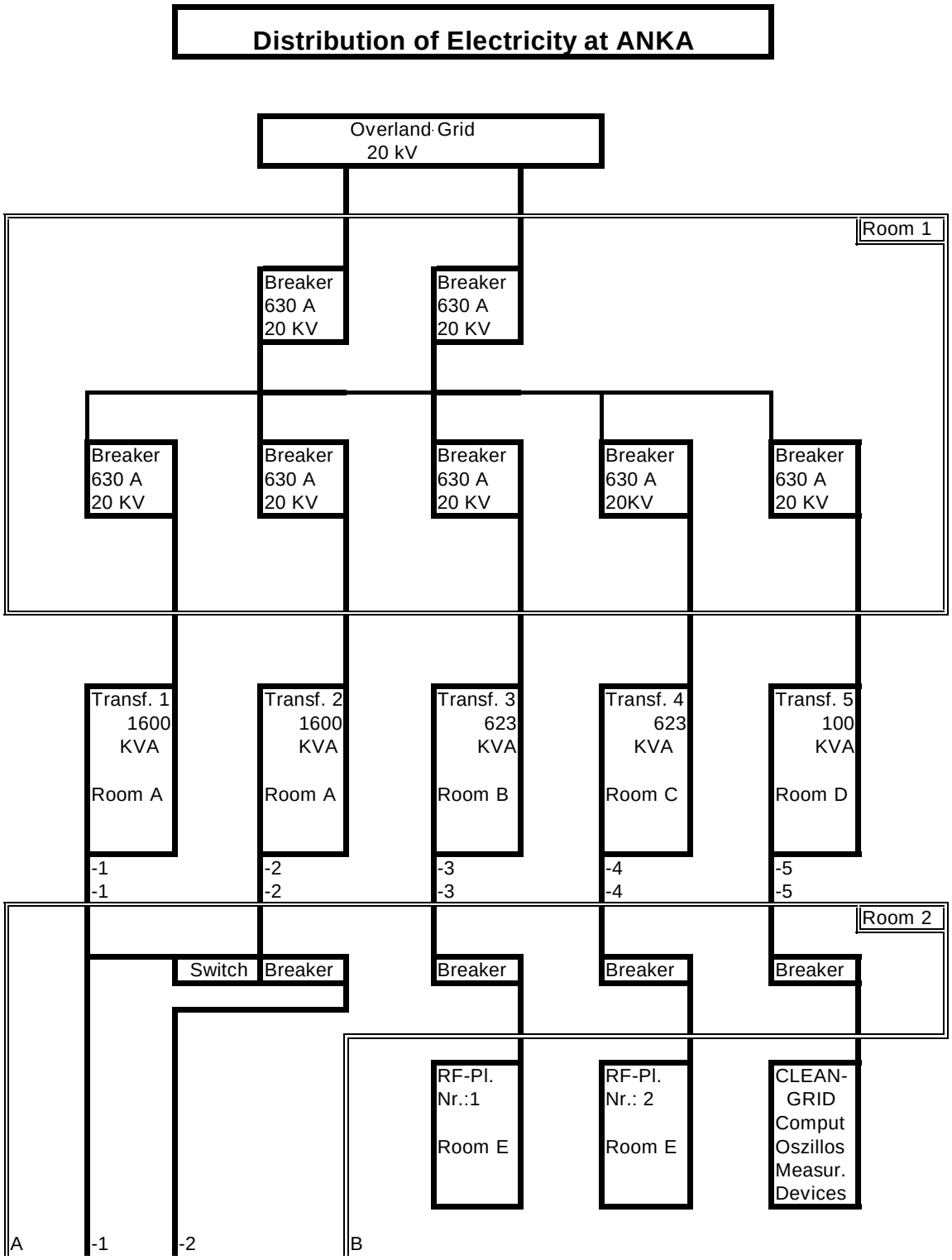
I-K / 0.75-1	Service Room			2 times	
I-K / 2-2.5	Office		Yes	4 times	
I-K / 2.5-3	Office		Yes	4 times	
I-K / 3.5-4	Staircase			2 times	
I-K / 4-4.5	Office		Yes	4 times	
I-K / 4.5-5	Office		Yes	4 times	
I-K / 5-5´	Office		Yes	4 times	
I-K / 5´-6´.5	Store Room			2 times	
I-K / 6´.5-7	Office		Yes	4 times	
I-K / 7-7.5	Office		Yes	4 times	
I-K / 7.5-8	Buffet	Yes		2 times	
I-K / 8-8.5	W.C. (Female)	Yes		1 times	
I-K / 8.5-9	W.C. (Male)	Yes		1 times	
I-K / 9-9.5	Staircase			2 times	
I-K / 9.5-10	Filling Room			2 times	

13.3 Infrastructure

The infrastructure is needed to run the facility with the accelerator as well the beam lines and for the preparation of the experiments. As infrastructure the following so called mechanics items are needed: pressure air, tap water and drainage, chemical outlet, chemical exhaust, darkening shutters, air exhaust, dry nitrogen, and liquid helium. In Table (13.1) all rooms of the ground floor are enumerated and the corresponding needed infrastructure is listed. In Table (13.3) the same has been done for the rooms of the first floor.

For running the accelerator as well as the experiments a so-called clean net is needed. The overall distribution of the electricity for the whole facility ANKA is shown in the Tables (13.9) and (13.10). The same distribution should be used for SESAME.

Table 13.9: Distribution of the electricity for the operation of a synchrotron light source, as an example ANKA at the Research Center Karlsruhe. This electrical distribution could also be used for SESAME.



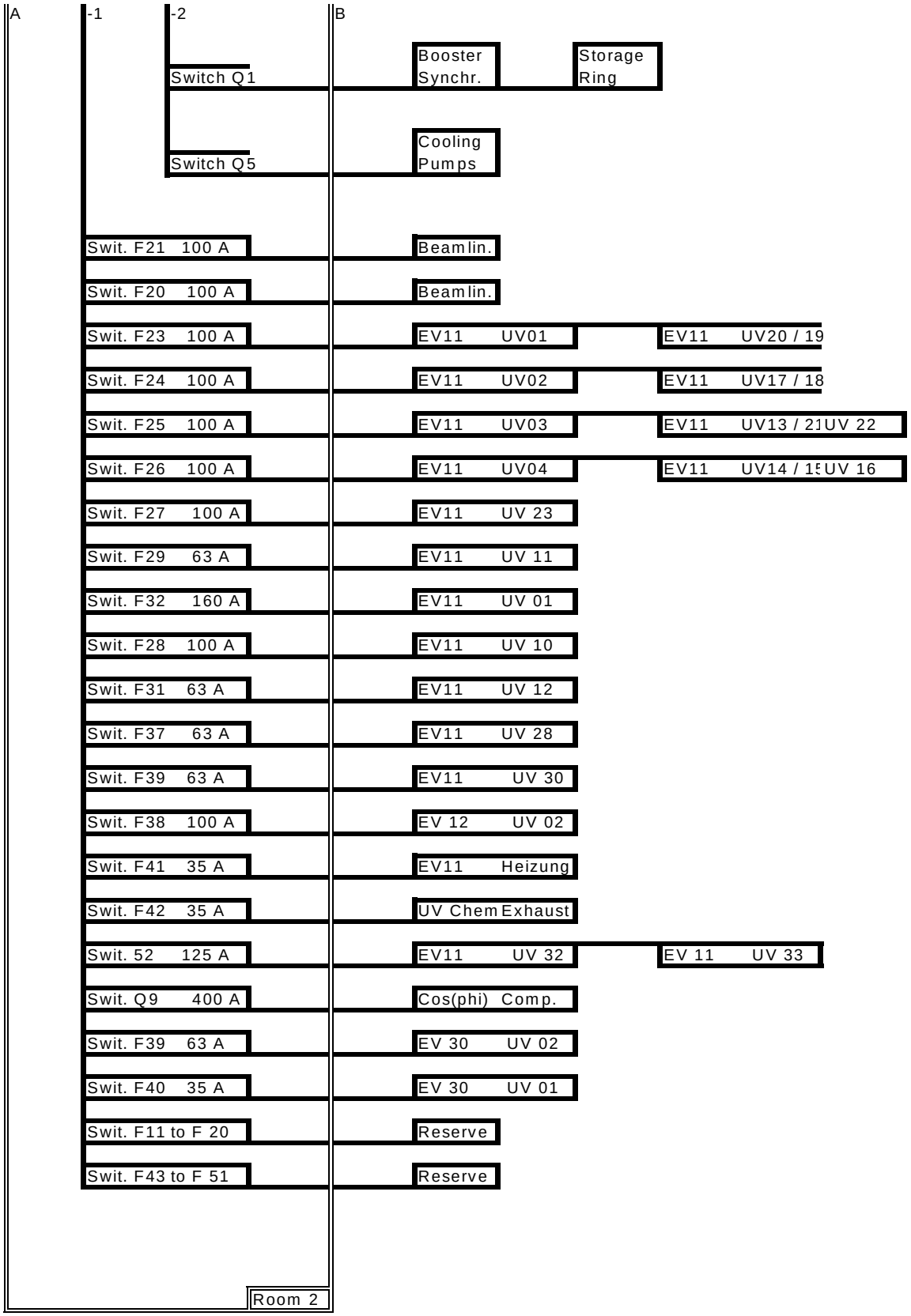

A
-1
-2
B
Switch Q1
Booster Synchr.
Storage Ring
Switch Q5
Cooling Pumps
Swit. F21 100 A
Beamlin.
Swit. F20 100 A
Beamlin.
Swit. F23 100 A
EV11 UV01
EV11 UV20 / 19
Swit. F24 100 A
EV11 UV02
EV11 UV17 / 18
Swit. F25 100 A
EV11 UV03
EV11 UV13 / 21
UV 22
Swit. F26 100 A
EV11 UV04
EV11 UV14 / 15
UV 16
Swit. F27 100 A
EV11 UV 23
Swit. F29 63 A
EV11 UV 11
Swit. F32 160 A
EV11 UV 01
Swit. F28 100 A
EV11 UV 10
Swit. F31 63 A
EV11 UV 12
Swit. F37 63 A
EV11 UV 28
Swit. F39 63 A
EV11 UV 30
Swit. F38 100 A
EV 12 UV 02
Swit. F41 35 A
EV11 Heizung
Swit. F42 35 A
UV Chem Exhaust
Swit. 52 125 A
EV11 UV 32
EV 11 UV 33
Swit. Q9 400 A
Cos(phi) Comp.
Swit. F39 63 A
EV 30 UV 02
Swit. F40 35 A
EV 30 UV 01
Swit. F11 to F 20
Reserve
Swit. F43 to F 51
Reserve
Room 2

Table 13.10: Explanation of the breakers and switches used in Table (13.9)

Switches and Electrical Distribution

SESAME Building

Name	Distributor		Power	Voltage	Current	Comments
Q 1	EV 11	UV 08/09	1.725 MVA	400 V	2500 A	This is the current layer to the inner side of the ring
Q 2	EV 11		276 kVA	400V	400 A	Primaerkuehlung im Raum 2.1.2 (Was ist dies genau)
Q 3	EV 11		1.725 MVA	400 V	2500 A	Input from transformator Nr.: 2, Output formfield 1 - 3
Q 4	EV 11		1.725 MVA	400 V	2500 A	Connection from field 4 to field 7 (bridging the trafos)
Q 5	EV 11		1.725 MVA	400 V	2500 A	Input from transformator Nr.:1, Output for field 6 - 11
Q 6	EV 11		1.725 MVA	400 V	2500 A	Connection to the cooling building
Q 7	EV 11	UV 05	276 kVA	400 V	400 A	Distribution innerside of the ring (east direction)
Q 8	EV 11	UV 06	276 kVA	400 V	400 A	Distribution innerside of the ring (west direction)
Q 9	EV 11		276 kVA	400 V	400 A	Cos (phi) compensation unit
F 21	EV 11	UV 46	86 kVA	400 V	125 A	Distribution for the beamlines (east direction) UV 46
F 22	EV 11	UV 45	86 kVA	400 V	125 A	Distribution for the beamlines (west direction) UV 45
F 23	EV 11	UV 01	69 kVA	400 V	100 A	Socket distribution (for new installations) UV 19 / UV 18
F 24	EV 11	UV 02	69 kVA	400 V	100 A	As F 23, 4*16A (2 phases), 2*16A (3 phases), 1*32A (3 phases)
F 25	EV 11	UV 03	69 kVA	400 V	100 A	As F 23, 4*16A (2 phases), 2*16A (3 phases), 1*32A (3 phases)
F 26	EV 11	UV 04	69 kVA	400 V	100 A	As F 23, 4*16A (2 phases), 2*16A (3 phases), 1*32A (3 phases)
F 27	EV 11	UV 23	69 kVA	400 V	100 A	As F 23, Electricity for very fast actions, basic supply for the hall
F 28	EV 11	UV 10	69 kVA	400 V	100 A	As F 23, Supply for the chemical laboratory
F 29	EV 11	UV 11	43 kVA	400 V	63 A	Socket distribution for the cooling room
F 31	EV 11	UV 12	43 kVA	400 V	63 A	Socket distribution for utilities (heating room)
F 32	EV 12	UV 01	110 kVA	400 V	160 A	Distribution for the controll room
F34	EV 11		14 kVA	400 V	35 A	Electricity for the crane
F 36	EV 30	UV 02	4 kVA	110 V	35 A	Connection to the puffer battery (110 V)
F 37	EV 11	UV 28	43 kVA	400 V	63 A	Socket distribution in the "Low Voltage Room"
F 38	EV 12	UV 02	69 kVA	400 V	100 A	Additional distribution for the inner side of the ring
F 39	EV 11	UV 30	43 kVA	400 V	63 A	Socket distribution for the "Medium Voltage Room"
F 40	EV 30	UV 01	14 kVA	400 V	35 A	Security lightening
F 41	EV 11	UV-Heat.	14 kVA	400 V	35 A	Socket distribution for the heating room
F 42	EV 12	UV-Chem	14 kVA	400 V	35 A	Electricity for the chemical exhaust
F 52	EV 11	UV 32/33	86 kVA	400 V	125 A	Distribution for the "Low Voltage Room"

13.4 Cooling System

For the operation of the accelerators as well as the beam lines a cooling system is needed. Overall an electricity power of roughly 3 MW is installed and this has to be cooled down. In the following subsection the first layout of the cooling system will be discussed. The principle of a cooling scheme is presented in Figure (13.8). It exists of the chiller system (D), the pumping station (B) and the air conditioning (C). Over the pumping station B the cooled water will be pumped through the different elements (magnets, cavity, klystron etc) and will cool them down. Normally the entrance temperature for the elements will be 19 degrees and the outlet will be 34 degrees. The air conditioning, which has to temper the experimental hall, must be cooled by the chiller system too.

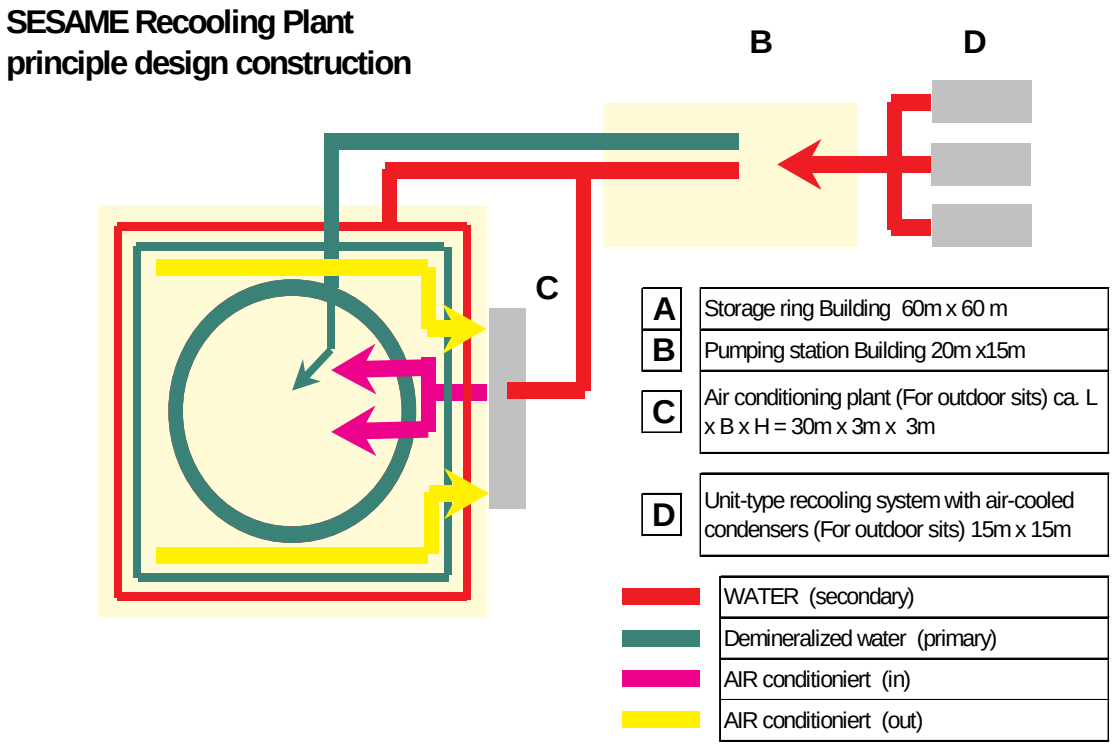


Figure 13.8: The principle layout of the cooling system for the accelerator as well as the experimental hall of SESAME

For the design of the system the consumption of the electricity is required. In Figures (13.9) and (13.10) the consumption of the 250 kW RF-plant, the magnets of the storage ring and the 800 MeV injector are summarized. The consumption for the building, the cooling plant and the beam lines are taken over from ANKA.

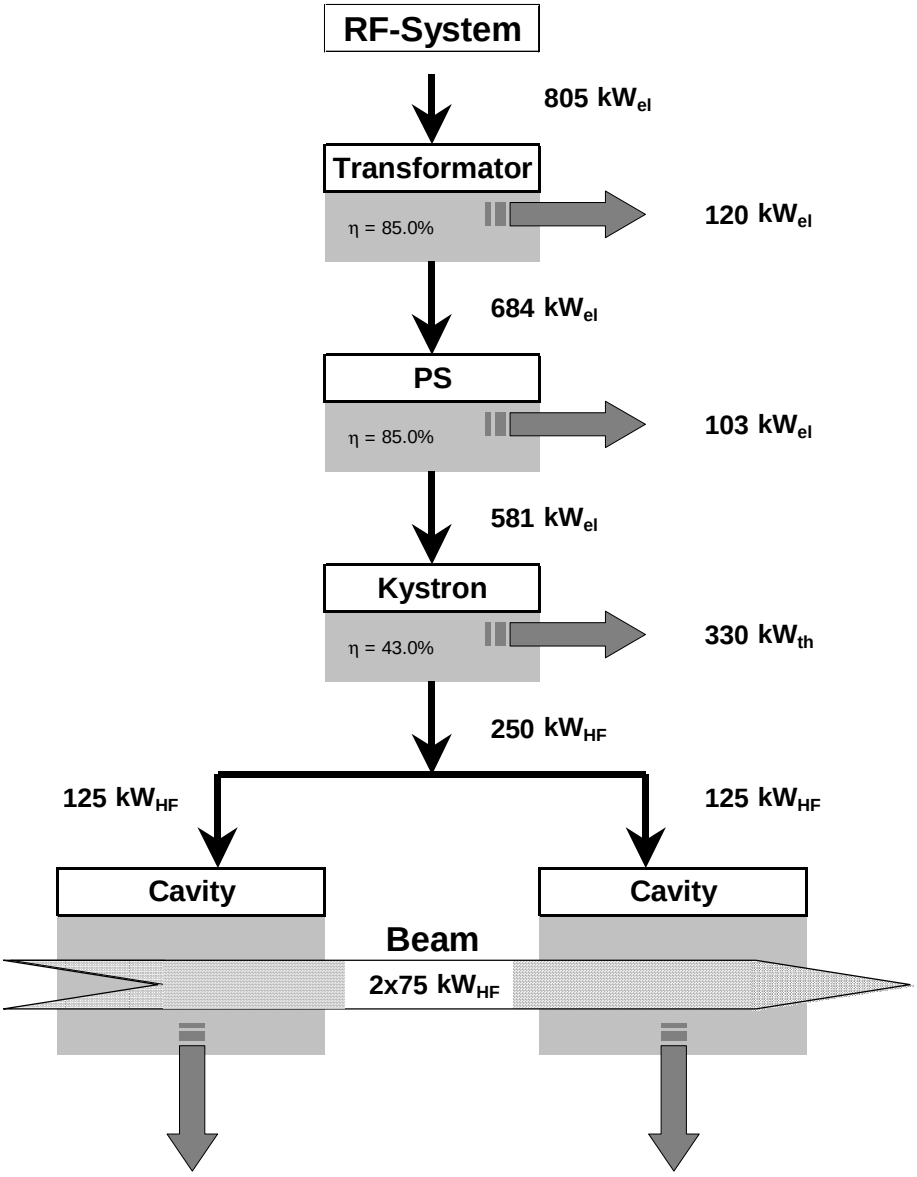


Figure 13.9: Power consumption for the operation of a RF-plant with a capacity of 250 KW

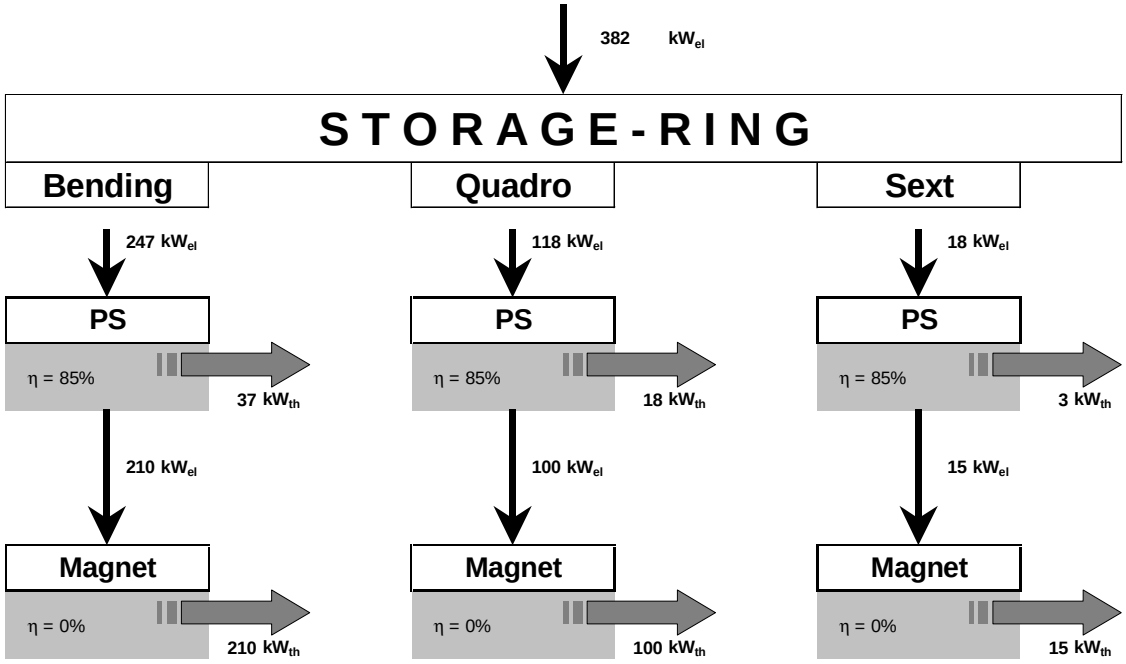


Figure 13.10: Power consumption for the operation of the magnets of the 2.0 GeV storage ring SESAME

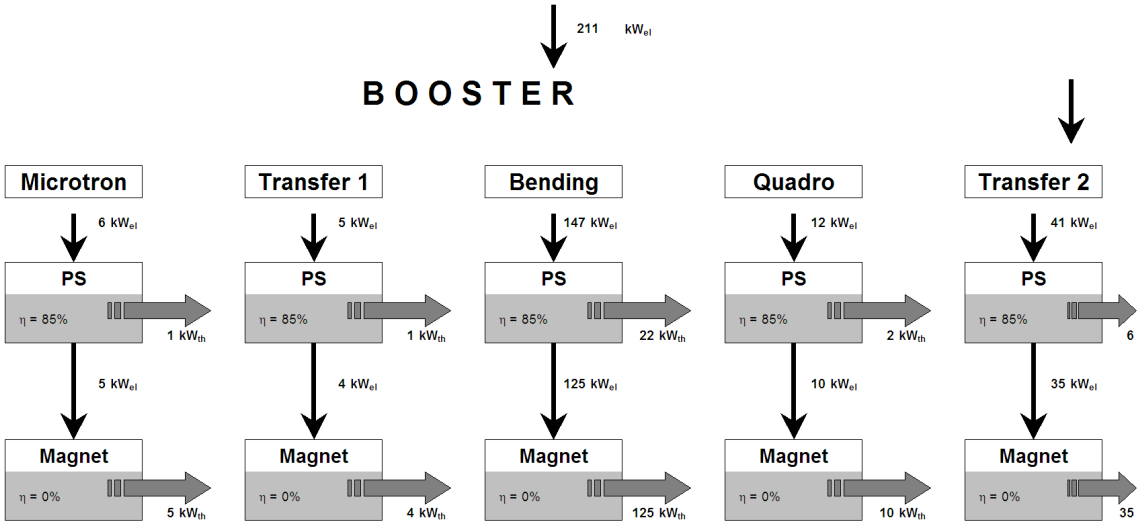


Figure 13.11: Power consumption for running all the elements of the injector

With the above estimations and assuming for the building 0.2 MW, for the cooling plant 1.3 MW, and for the beam lines 0.2 MW, the overall electricity consumption will be 3.3 MW as shown in Figure (13.11).

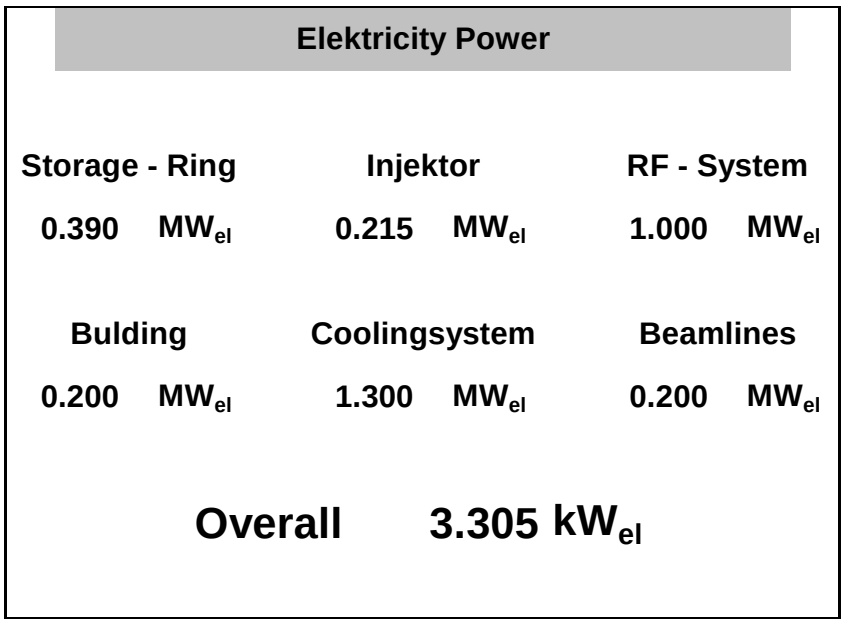


Figure 13.12: Overview of the power consumption of the synchrotron light source SESAME

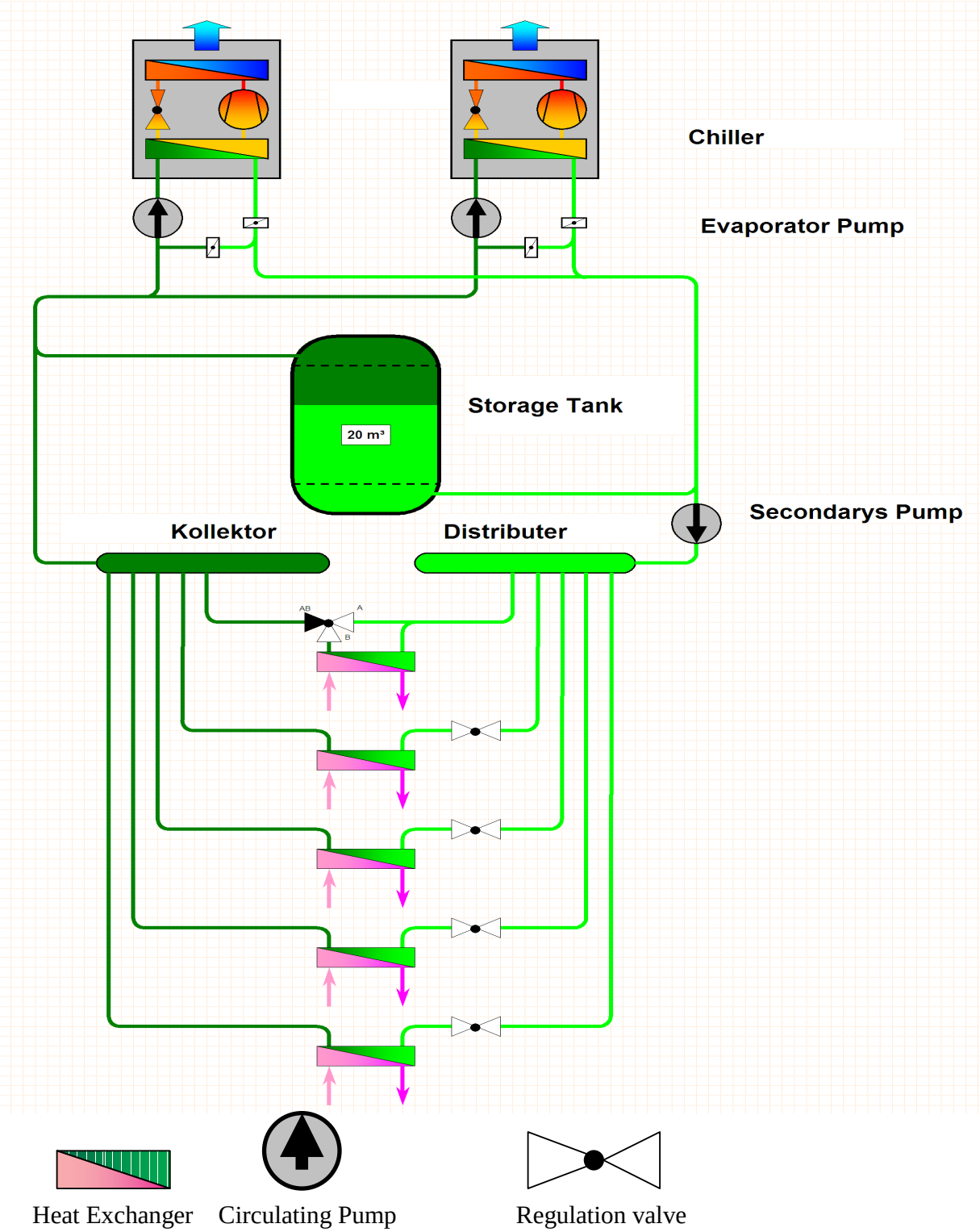


Figure 13.13: Overview of the secondary cooling scheme for the accelerators with the cooling circuits for the booster, storage ring magnets, RF-system, beam lines etc. Each chiller has a capacity of 1 MW. The secondary cooling circuit is running within the temperature range of 10 to 15 degrees. From the heat exchanger starts the primary cooling with circuits of 20 to 35 degrees.

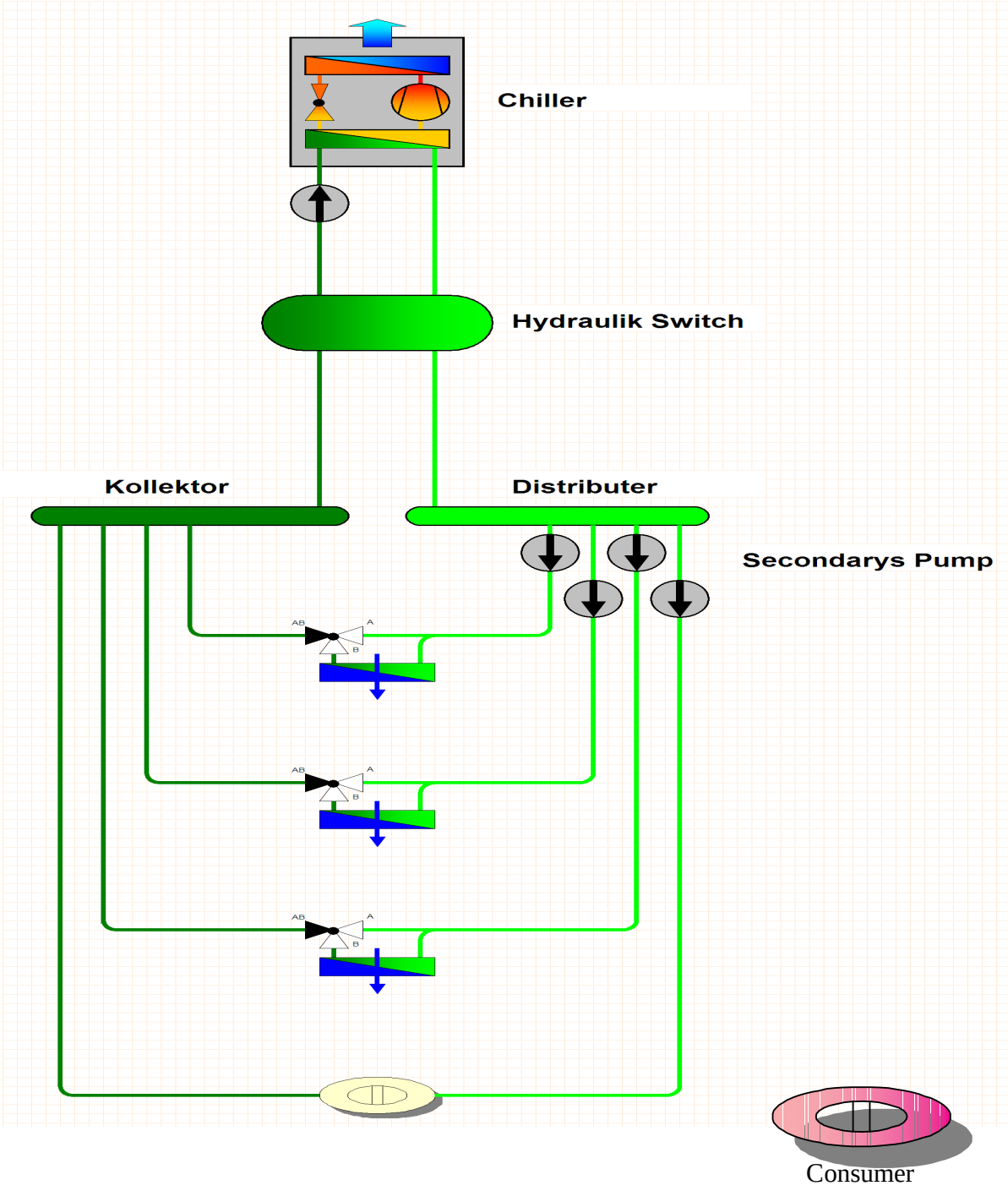


Figure 13.14: Overview of the secondary cooling circuit for the HVAC-system. The explanations are the same as in Figure (13.13). The three secondary circuits are for the 2 machines of the HVAC system and one for the beam lines.

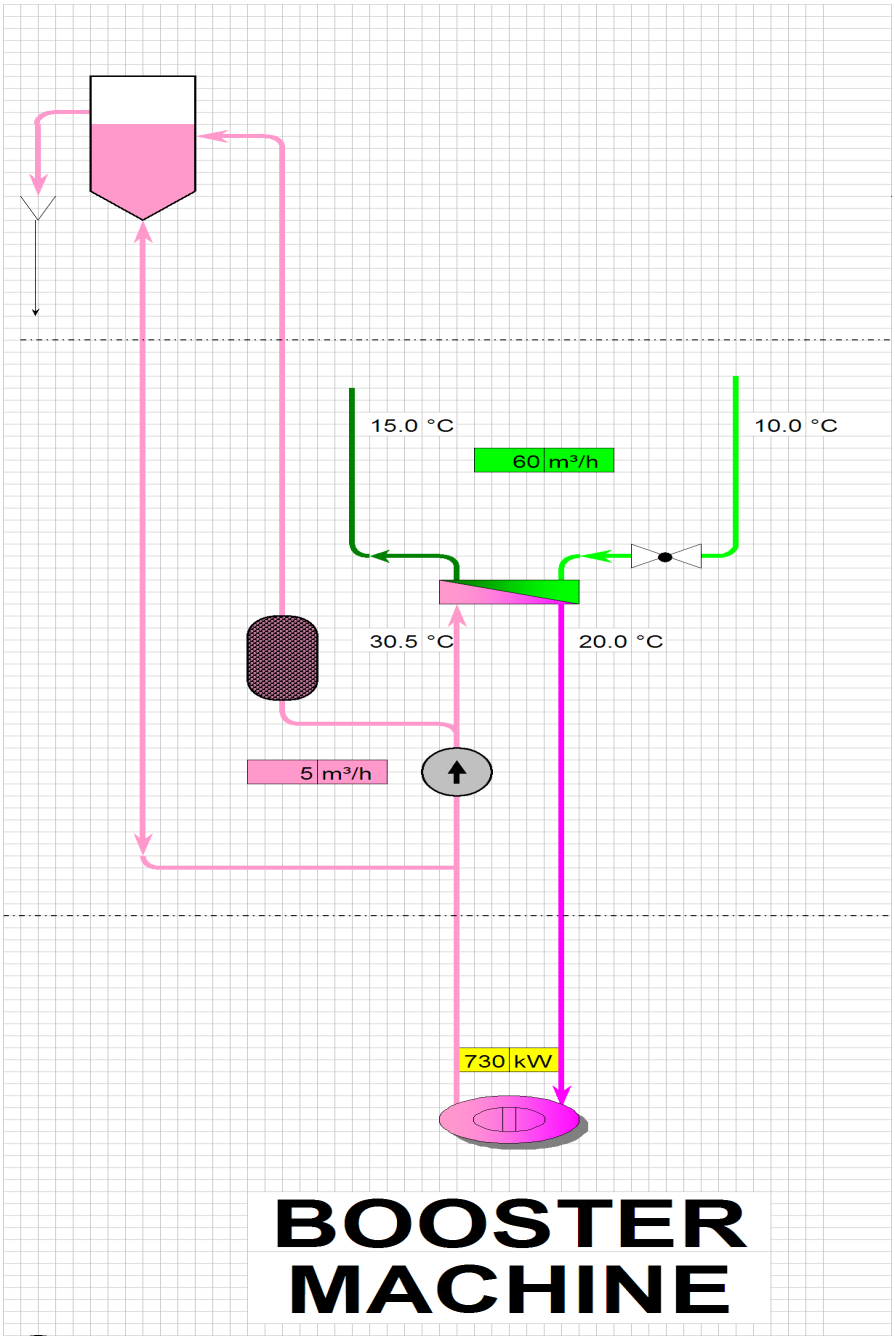


Figure 13.15: Primary circuit for the cooling of the booster and the magnets of the storage ring. The location of the extension tank must be on the roof of the experimental hall (see Figure (13.17))

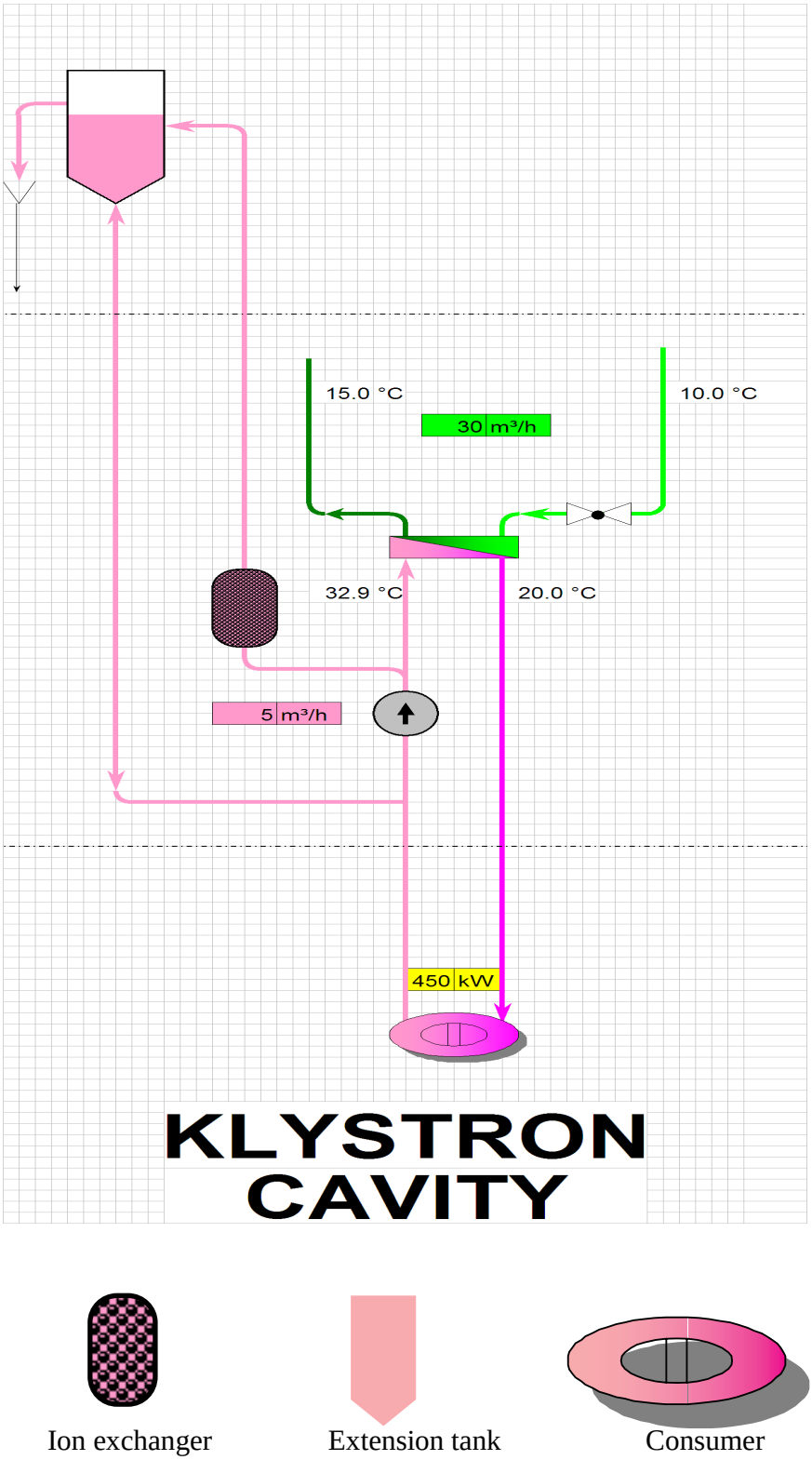


Figure 13.16: Primary circuit for the cooling of the klystron and the cavities of the storage ring. For the location of the different components see Figure (13.17).

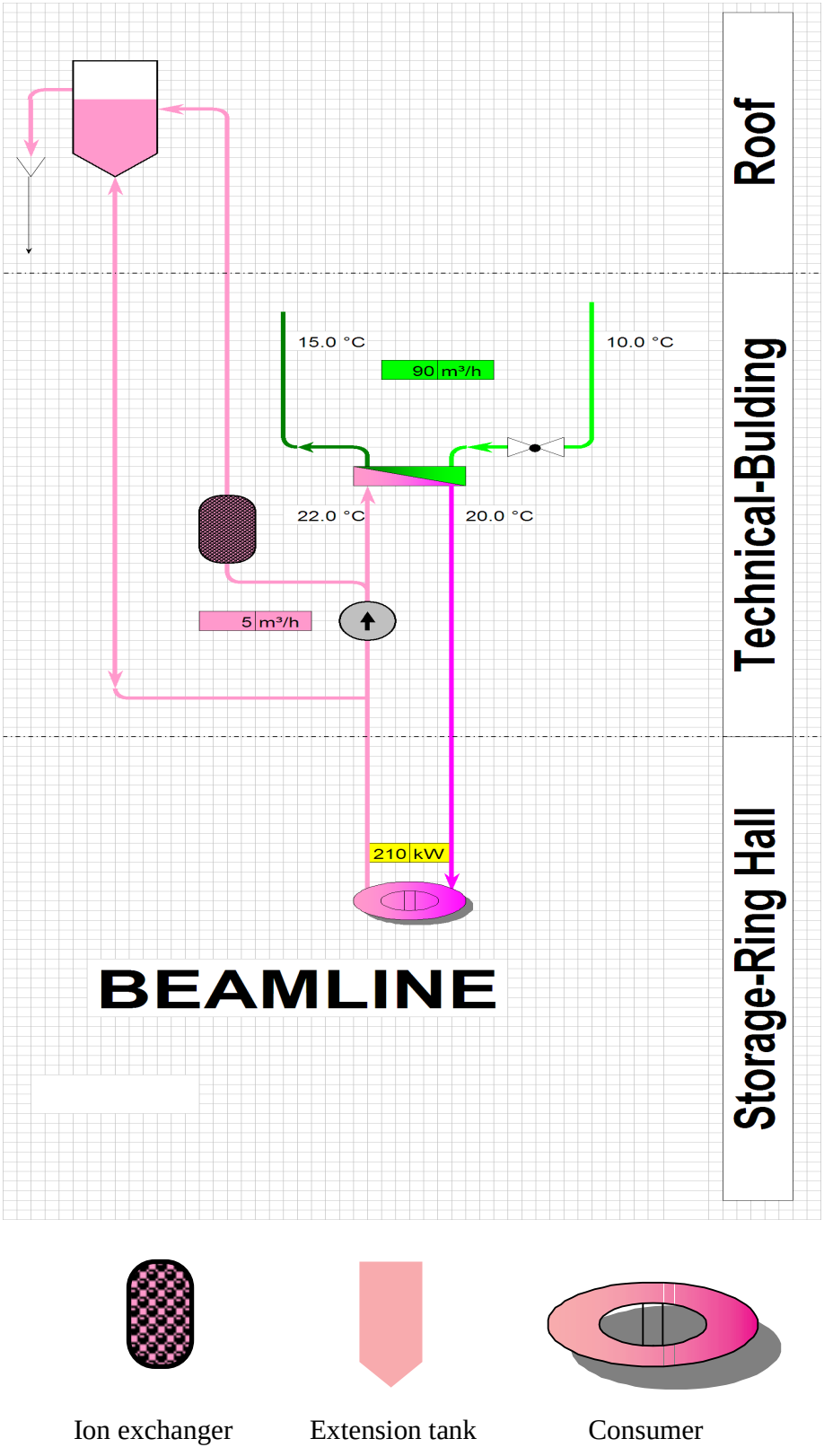


Figure 13.18: Primary circuit for the cooling of the beam lines. The location of the different components is indicated.