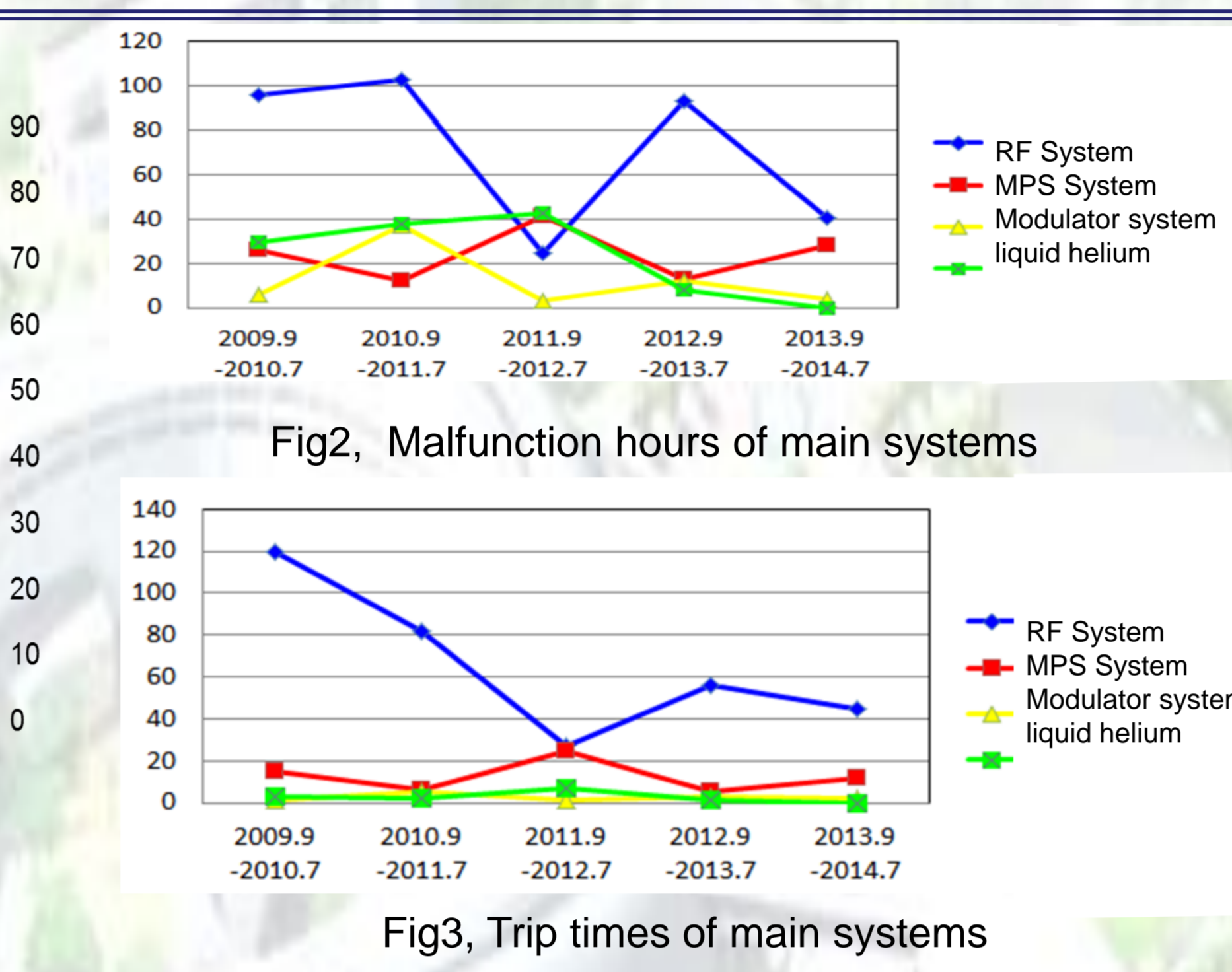
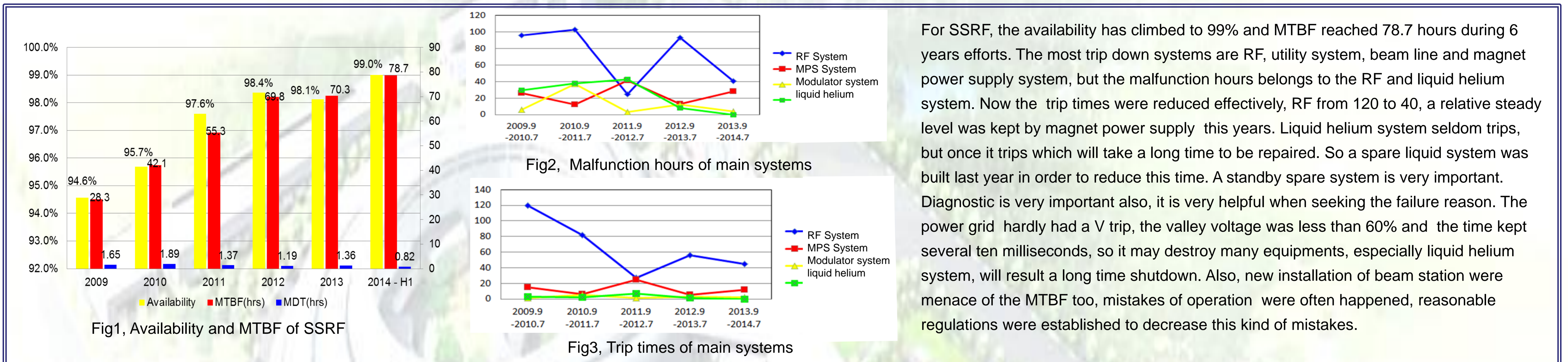


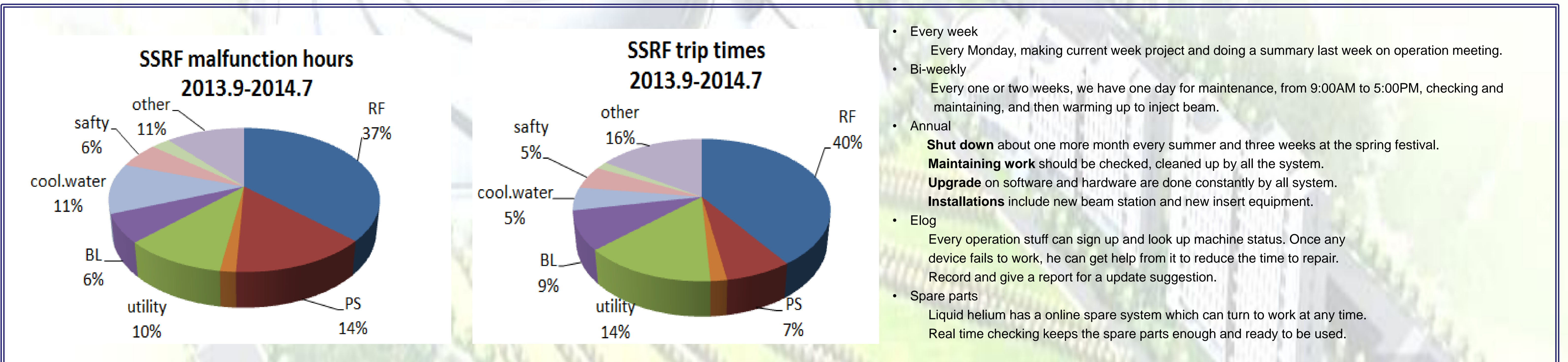


Abstract

The Shanghai Synchrotron Radiation Facility (SSRF) has opened to users for six years. The availability reached 99% last year due to the staffs' efforts. Lots of ways were tried to increase the machine reliability, such as ELOG informing system, workshop to statistic and analyze reasons, prepare enough spare parts and so on. Therefore, hardware faults can be solved as quickly as possible. Two main systems, RF and magnet power system, will be described much more in this paper than other systems which will also be introduced briefly.



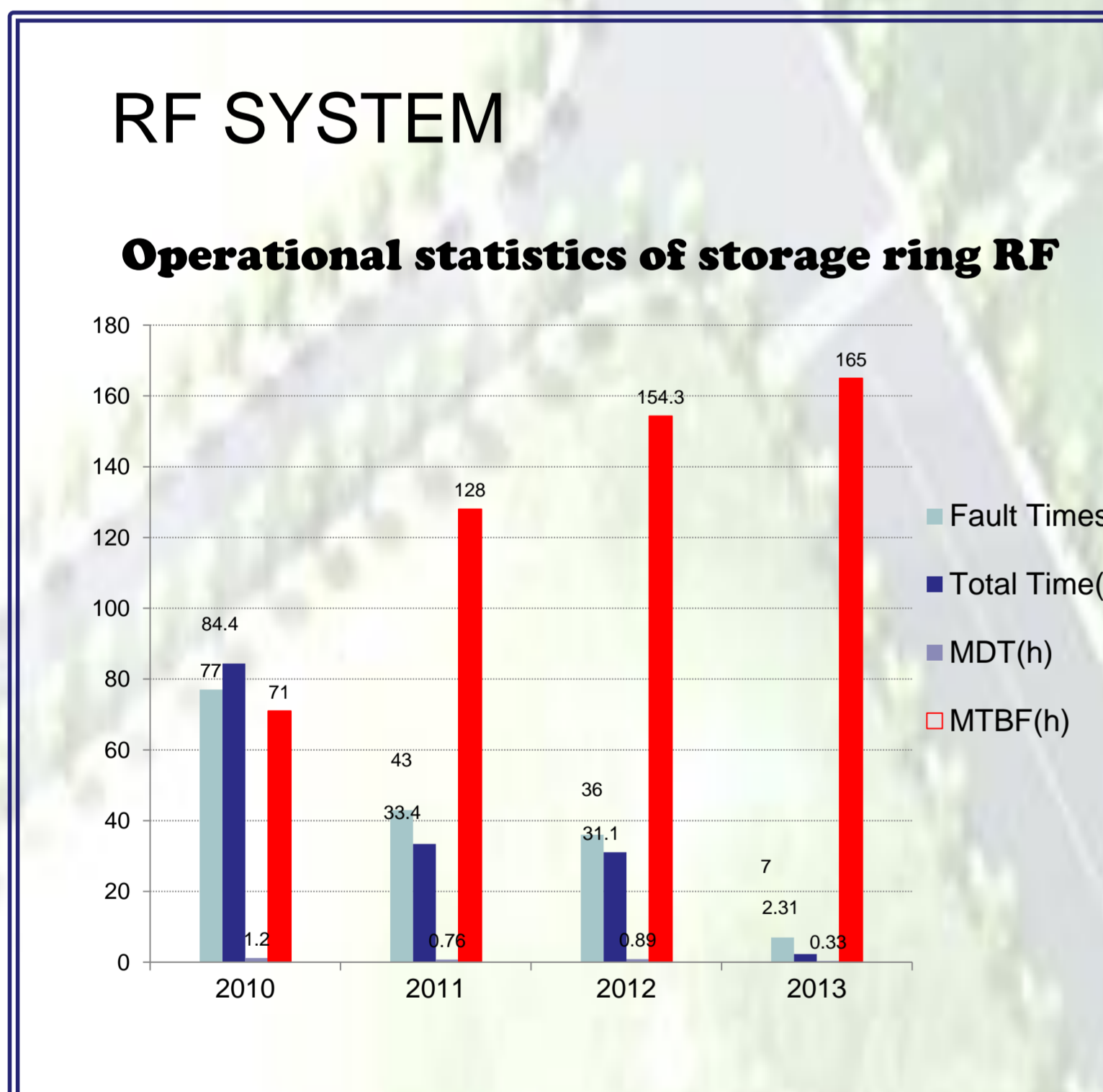
For SSRF, the availability has climbed to 99% and MTBF reached 78.7 hours during 6 years efforts. The most trip down systems are RF, utility system, beam line and magnet power supply system, but the malfunction hours belongs to the RF and liquid helium system. Now the trip times were reduced effectively, RF from 120 to 40, a relative steady level was kept by magnet power supply this years. Liquid helium system seldom trips, but once it trips which will take a long time to be repaired. So a spare liquid system was built last year in order to reduce this time. A standby spare system is very important. Diagnostic is very important also, it is very helpful when seeking the failure reason. The power grid hardly had a V trip, the valley voltage was less than 60% and the time kept several ten milliseconds, so it may destroy many equipments, especially liquid helium system, will result a long time shutdown. Also, new installation of beam station were menace of the MTBF too, mistakes of operation were often happened, reasonable regulations were established to decrease this kind of mistakes.



- Every week
Every Monday, making current week project and doing a summary last week on operation meeting.
- Bi-weekly
Every one or two weeks, we have one day for maintenance, from 9:00AM to 5:00PM, checking and maintaining, and then warming up to inject beam.
- Annual
Shut down about one more month every summer and three weeks at the spring festival.
Maintaining work should be checked, cleaned up by all the system.
Upgrade on software and hardware are done constantly by all system.
Installations include new beam station and new insert equipment.
- Elog
Every operation staff can sign up and look up machine status. Once any device fails to work, he can get help from it to reduce the time to repair.
Record and give a report for a update suggestion.
- Spare parts
Liquid helium has a online spare system which can turn to work at any time.
Real time checking keeps the spare parts enough and ready to be used.

RF SYSTEM

Operational statistics of storage ring RF



Main trips from 2012 to now include:
Trips over 4 times
FBT Vacuum burst, 11 times;
Insulation vacuum burst, 4 times.
Circulator and load arc, 5 times
Trips with long break-down time
Damaged kinds of auxiliary power
Total 12hours.
Frequently on SCC2 and 3.
Typically shows:
Sudden voltage decrease
Big outgas from FBT or POB
Solution:
Thermal cycle
Pulse conditioning
CW conditioning

During the nearly 4-years operations of SSRF with users, many trips and problem of Storage ring system have been solved, which make the system more reliable and stable for 220mA@3.5Gev beam operation.
There are still some unsolved trips, like FBT vacuum burst, insulation vacuum burst, vibration of transmitter 3' s output.
We are now trying to fight the way to solve them.
Over 600kW RF power will be demanded by the future SSRF phase-II project, which means each cavity should provide over 200kW power.
How to overcome the multipacting and window vacuum burst will be the biggest challenge for super conducting cavities.
How to keep the high stability with the gradual degradation of devices will be also a big challenge.

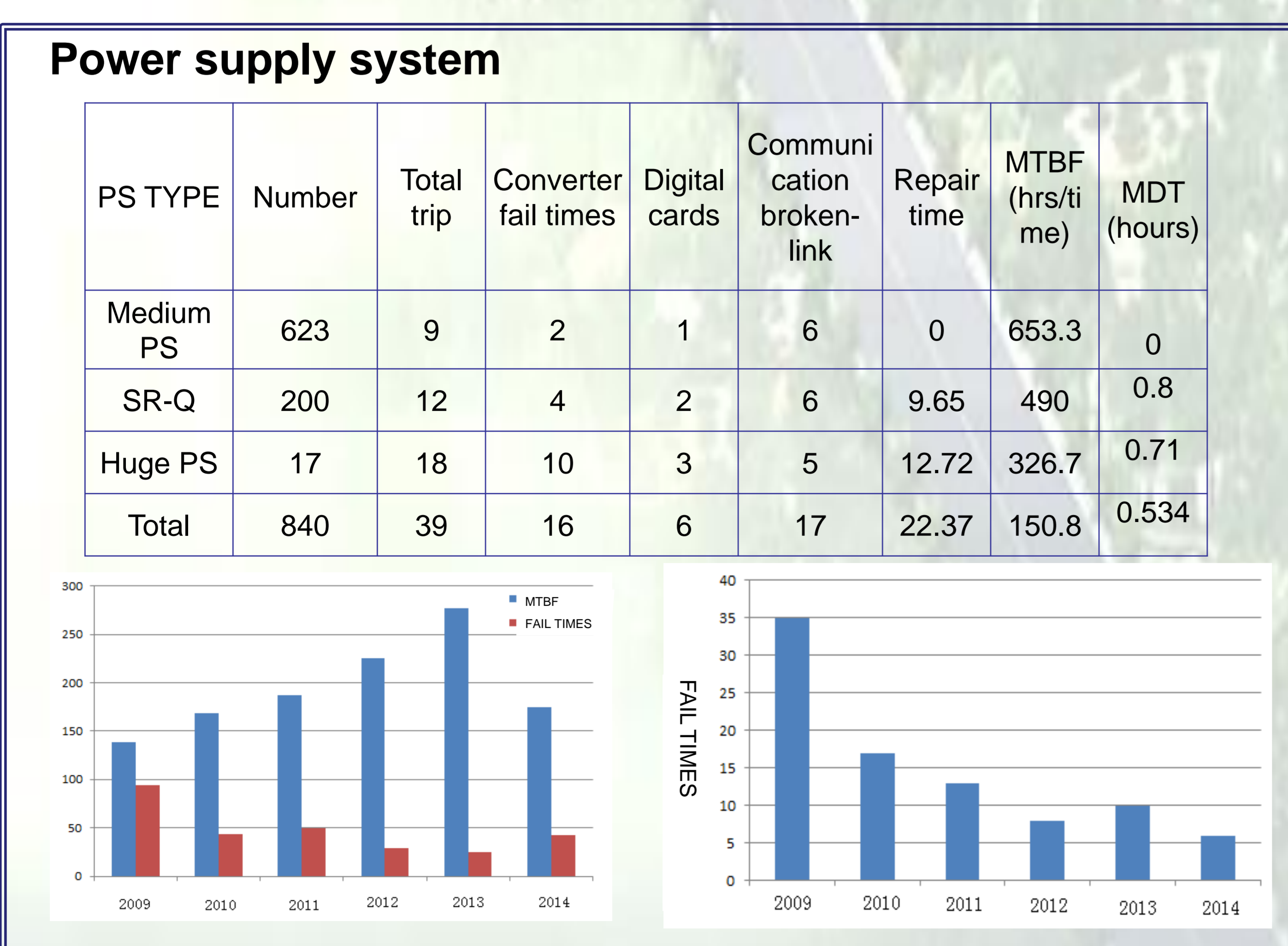
Utility SYSTEM

DATE	TIME	GRID VARY(%)	LAST TIME(s)
2014.3.13	6:50:26	93.10	0.052
2014.3.16	12:03:32	82.06	0.073
2014.3.19	15:10:57	93.73	0.077
2014.3.23	7:07:16	86.15	0.095
2014.4.06	10:21:59	93.37	0.488
2014.4.09	11:12:02	71.31	0.075
2014.4.26	8:01:45	94.87	0.025
2014.4.27	12:51:28	94.98	0.112
2012.04.30	18:51:20	94.83	0.739
2014.05.11	6:43:45	79.06	0.079
2014.05.20	9:28:04	86.45	0.023
2014.05.23	12:53:06	93.89	0.021
2014.06.15	23:30:00	91.3	0.023S
2014.07.05	18:28:49	94.97	0.03
2014.07.09	21:09:08	94.70	0.03
2014.07.09	14:15:52	68.02	0.09
2014.07.10	12:30:40	91.69	0.334
	11:00:14	81.82	0.34
2014.07.12	12:32:51	91.18	0.315
	20:44:29	80.98	0.247
2014.07.15	4:02:20	89.14	0.062

Power grid often had a deep trip and seldom caused a critical damage, for example:
10/26,2013, result liquid helium fail and RF shutdown suddenly, stop beam for 29.5 hours.
4/9,2014, caused beam stop for 13.9 hours.
7/9,2014, caused beam stop 12.03 hours.

Power supply system

PS TYPE	Number	Total trip	Converter fail times	Digital cards	Communi cation broken-link	Repair time	MTBF (hrs/ti me)	MDT (hours)
Medium PS	623	9	2	1	6	0	653.3	0
SR-Q	200	12	4	2	6	9.65	490	0.8
Huge PS	17	18	10	3	5	12.72	326.7	0.71
Total	840	39	16	6	17	22.37	150.8	0.534



There are More than 840 power supplies in SSRF, and the MTBF is about 150 hours last year.

1. Auxiliary power fails.
2. The handle of the main relay(BS-Q,SR-B) was broken when it was turned on.
3. Cooling water pipe aged and leaked.
4. Only 20 power supplies which are booster ring Q & B and storage ring S & B are cabinet structure, so they must be repaired on it on field. SR-B current drifted 0.75A over 5 days shown in the following figure. Several ways were tried to find the problem which was caused by ADC card. This was a typical example that some problems were deep hidden.
5. All the other power supplies are module structure, which just need exchange a spare module and repair the failure one offline.
6. It is truth that a good designed power supply should have more margin and consequently reliable.

