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## SKI-JUMP LIMITATIONS AND PLAN'S SOLUTIONS

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Reports on Chinese naval aviation have been in the news lately and Chinese media is abuzz with photographs of the J-15 fighters operating from the PLAN's first carrier – the Liaoning. The carrier was en-route to Hong Kong<sup>1</sup> along with two escort warships when the flight operations were conducted. The PLAN even released a long video of the operations which gives some insights into the J-15 fighter and the role it will play. There is also some news on China building a carrier borne AEW aircraft to be operated from its CV-001 type vessels.<sup>2</sup> China's lone carrier, the refurbished old Soviet vessel – Varyag – is PLAN's first experience with an aircraft carrier which it is so actively and boastfully projecting. China is steadily improving and adding up to its naval power projection capability.

The released video was of very good resolution where every minute detail was visible and which enables inference of certain information.<sup>3</sup> The video primarily contains take-offs and landings of the J-15 fighter with and without load-outs. In several take-offs, the J-15 can be seen carrying the PL-12 medium range and PL-8 short range air-to-air missile in the middle and outer hard-points respectively. The PL-12 is an active radar-guided BVR missile and is similar to the Russian R-77 Adder and it is widely claimed that its seeker head is the same design as that of the R-77.<sup>4</sup> The PL-8, on the other hand, is an IR guided missile and is believed to be based on the Israeli Python-3.<sup>5</sup> In few other launches the aircraft can be seen taking off and landing with two YJ-83K anti-ship missiles slung under the centre-wing hard-point on each wing. The colour-coding on the air-to-air and anti-ship missiles indicate that those were inert training/exercise missiles. This indicates that the J-15 – an air superiority fighter – will be employed for maritime strikes as well, in addition to fleet air defence role, despite being operated from a ski-jump carrier.

What is to be understood is that although the J-15 is a highly capable fighter, there are limitations for the aircraft while operating from a ski-jump equipped carrier. In a carrier like Liaoning where there is no CATOBAR to assist takeoff, the aircraft will have to get airborne with its own power assisted by a 14 degree ski-jump. The main problem here is that this arrangement cannot launch heavier aircraft, and also the fighter fuel load would have to be traded off for weapon load. This would affect the range of the aircraft. Moreover, the J-15 is a heavier class fighter and large in dimension which forces a restriction on the number of fighters that could be carried on the Liaoning. This is one reason why Russia replaced their carrier based heavy Su-33 with the lighter and cheaper naval MiG-29K though the Su-33 is a more capable aircraft<sup>6</sup> with better air-combat capability, reduced wing load and other merits like better range and flight ceiling. However, in the recent campaign against ISIS in the Middle East, Russia has been operating both the MiG-29 and the Su-33 aircraft in addition to the Su-25UTG from their carrier.<sup>7</sup>

Despite the above limitations, the Chinese have chosen the heavier but more capable Su-33 copy – the J-15. As mentioned above, loading a fighter with more munitions would mean reduced combat radii. As seen from the video, the fighters configured for maritime strike was carrying two YJ-83 missiles which means that there must have been trade-off with fuel, reducing their already restricted combat radii due to the limitations of operating from a ski-ramped take-off system. The only way to overcome this issue is to have mid-air refuelling capability. But the problem for China is that PLAAF has very limited number of mid-air refuelling tankers that could refuel the Flanker variants. China's last purchase of three used Il-78 tankers from Ukraine took place in 2014.



*Source: Extracted from the PLAN video*

The recent video released by PLAN might reveal how it intends to overcome this challenge.<sup>8</sup> The first aircraft that takes-off in the video does not carry any weapon, but an external tank like structure can be seen attached under the fuselage (between the two intakes). A buddy refuelling pod like structure can be clearly observed under the fuselage of another J-15 taxiing on the deck. The appearance of the pod doesn't look like the domestic RDC-1 system, but resembles the Russian UPAZ-1 refuelling pod. Hence, buddy refuelling might be the interim solution of the PLAN to address the

problem of combat radii with a heavier weapon load configuration launched from its Type 001 vessels.



*Source: Extracted from the PLAN video*

It is well known that the J-15 was built with a retractable refuelling probe on the port side nose. Earlier in 2014, images of the J-15s engaged in buddy refuelling using the UPAZ-1 pod or a pod based on the Russian UPAZ-1 system were released.<sup>9</sup> Though buddy refuelling is a complex flight operation, it appears that PLAN pilots have become proficient enough as the PLAN is actually employing the tactic. This would boost the J-15's combat radii while operating from the Liaoning. For maritime anti-ship strikes, buddy refuelling would extend the range in addition to the strike range of the YJ-83 ASCM which can strike a target at a distance of 150 to 200 km. For air defence, this could mean longer patrolling time and longer range air interdiction capability.



*Source: <http://shokidriver.blogspot.in/2015/01/chinas-air-refueling-pod-nearing.html>*



However, buddy refuelling only offers limited refuelling capability unlike a large dedicated tanker. One sortie of a J-15 buddy refuel aircraft will most likely cater for just one fighter. Moreover with Liaoning's limited J-15 carrying capability, there would be serious resource constraint. Employing some of the J-15s for in-flight refuelling requirement would mean that fewer aircraft will be available for additional sortie generation.

Nevertheless, these are just limitations with the present and the next carrier. China has just completed the construction of its first home built – and second carrier for its navy – which is expected to be commissioned before 2020<sup>10</sup> with its full complement of J-15 and assorted helicopters. The second carrier of the PLAN (Type 001) is also built based on the Russian Kuznetsov design with a ski-jump but it is a smaller vessel compared to Liaoning but will be capable of carrying more aircraft, according to Chinese media reports.<sup>11</sup> This would allow little more flexibility to the commander. China's future carriers would most likely have a catapult system which would negate the above mentioned limitations to a good extent.

The next variant of home built carrier – the Type 002 – is expected to be a larger vessel with a catapult launch system.<sup>12</sup> Already, the J-15s have been modified for catapult launch with necessary modification to the nose landing gear and probably sturdier airframe to withstand the mechanical stress of catapulted take-off.<sup>13</sup> Although steam catapulted carrier can launch heavier aircraft with higher weapon and fuel load, it would still require in-flight refuelling for extended range operations. For reasons of better combat capability, the J-15 fighter can be expected to be retained as the primary air element of future carriers as well. But until China manages to acquire more number of large and dedicated mid-air refuelling tanker aircraft, the navalised Flankers would have to be content with buddy refuelling.

In addition to the limitations of fighter operation, the ski jump carriers cannot launch AEW aircraft. In all such carriers the AEW and ASW component are the helicopters which are limited by range and speed. However, the Chinese are attempting to solve this problem by way of modifying the

existing KJ-500 AEW with a more powerful engine for short ski-ramp take off from a carrier and foldable wings for storage. For this, the Chinese language media reports that China is collaborating with Ukraine to develop such an engine.<sup>14</sup>

Ukraine has experience in developing such an engine for short and unassisted take off of heavy turboprop aircraft. The D-27 counter-rotating prop engine was developed for the Soviet YAK-44 AEW for unassisted take-off from a carrier. In the recent past the D-27 engine was redeveloped and is now powering the AN-70 military transport aircraft that is capable of STOF.<sup>15</sup> In 2016 Chinese industries signed an agreement with the Ukrainian Motor Sich company where the latter will undertake licenced manufacture (in China) of several aero-engines designed by the Ivchenko Design Bureau, including the D-27.<sup>16</sup>

The other engines approved for manufacture in China are the D-136, MS-500V and TV3-117VMA-SBM1V helicopter turboshaft engine, AI-450S general aviation aircraft engine , D436-148FM and D-18T high-bypass turbofan engine and AI-222 series military jet engine.<sup>17</sup> This collaboration will certainly turnout to be a major boost for Chinese aero-engine industries as the industries will gain the know-how of complex engine development.

Once Chinese aviation industries manage to integrate the D-27 engines with the KJ-500, the PLAN ski-ramp carriers will have their own version of the US E-2D AEW aircraft. Such an aircraft will more likely be deployed on China's second Type 001 carrier with ski-jump as it might have more space to store and operate the KJ-500s. This aircraft would immensely boost PLAN's carrier vessel combat capability by way of providing better protection to the carrier fleet via early warning at a longer distance.

An important aspect to be noticed is that the carrier vessel is of Soviet/Russian origin/design and the PLAN is following all the solutions and tactics that were practised or tried by the Soviet Navy. Hence, in the near future too, PLAN could follow Russian techniques for addressing minor and major challenges. But at the same time China is pushing for improving the combat effectiveness of its carrier fleet. There are some reports in the Chinese media that suggest that the first Type 002 carrier will be equipped with electromagnetic catapult system (EMALS). There are also some photos and satellite imageries that point to the possible presence of a land based EMAL test system in addition to a CATOBAR testing system.<sup>18</sup> Ma Weiming, an academician and the director of Electric and Electronics Engineering Institute under the Naval Engineering University, recently told in a seminar that the designers of the first Type 002 carriers have opted for EMAL system over the steam catapult.<sup>19</sup>

However, there is no official confirmation on this. Further, the credibility of this claim is very weak as without nuclear propulsion it would be difficult to meet the power requirement of an EMAL system.

*(Disclaimer: The views and opinions expressed in this article are those of the author and do not necessarily reflect the position of the Centre for Air Power Studies [CAPS])*

## Notes

<sup>1</sup> “Chinese aircraft carrier sails into Hong Kong in show of naval power”, <https://www.theguardian.com/world/2017/jul/07/chinese-aircraft-carrier-liaoning-sails-into-hong-kong-show-of-naval-power> , 7 July 2017

<sup>2</sup> 中国一神秘武器呼之欲出，助力辽宁舰划设死亡海上禁区！, [http://www.sohu.com/a/147666571\\_701550](http://www.sohu.com/a/147666571_701550) , 10 June 2017

<sup>3</sup> <https://www.youtube.com/watch?v=encV6n3hntA> , 2 July 2017

<sup>4</sup> PLA air-to-air missiles, <http://www.ausairpower.net/APA-PLA-AAM.html#mozTocId779953> , April 2012

<sup>5</sup> “PL-8”, <http://www.globalsecurity.org/military/world/china/pl-8.htm>

<sup>6</sup> “Sukhoi Su-33”, [http://www.military-today.com/aircraft/su\\_33.htm](http://www.military-today.com/aircraft/su_33.htm)

<sup>7</sup> “Russia’s aircraft carrier set for massive upgrade: The lethal MIG-29K”, <http://nationalinterest.org/blog/the-buzz/russias-aircraft-carrier-set-big-aircraft-upgrade-the-lethal-15769> , 13 April 2016

<sup>8</sup> No.3

<sup>9</sup> “歼 15 舰载机伙伴加油吊舱曝光加油速度居同类产品领先水平”, [http://www.guancha.cn/military-affairs/2014\\_01\\_04\\_197414.shtml](http://www.guancha.cn/military-affairs/2014_01_04_197414.shtml) , 04 January 2014

<sup>10</sup> “China’s new aircraft carrier”, <http://www.japantimes.co.jp/opinion/2017/04/30/editorials/chinas-new-aircraft-carrier/#.WXY2BoSGPDc> , 30 April 2017

<sup>11</sup> Ibid

<sup>12</sup> “CVA 002 aircraft carrier”, <http://www.globalsecurity.org/military/world/china/cv-002.htm>

<sup>13</sup> “歼 15 进行陆上电磁弹射实验中国电弹航母或提前上马”, <http://mil.news.sina.com.cn/china/2017-07-06/docifyhwefp0176825.shtml> , 6 July 2017

<sup>14</sup> “To avoid bankruptcy, Ukraine took out three core technologies, to promote China's arms to achieve three major leap”, [http://www.sohu.com/a/145768953\\_677682](http://www.sohu.com/a/145768953_677682) , 03 June 2017

<sup>15</sup> Ibid

<sup>16</sup> “Airshow China 2016: Ukraine's Motor Sich to begin licensed production in China”, <http://www.janes.com/article/65323/airshow-china-2016-ukraine-s-motor-sich-to-begin-licensed-production-in-china> , 07 November 2016

<sup>17</sup> “3000 Ukranian aviation experts will emigrate to China?”, <http://www.sina.com.cn/midpage/mobile/index.d.html?docID=fyhmrw4076678&url=news.sina.cn/gn/2017-06-27/detail-ifyhmtrw4076678.d.html> , 26 June 2017

<sup>18</sup> No.13

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<sup>19</sup>“电磁弹射器确定上航母：专家担心！002 开工时间或至少推迟 2 年”，[http://www.sohu.com/a/155201444\\_621017](http://www.sohu.com/a/155201444_621017) , 07 July 2017

